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ENVIRONMENTAL FEDERALISM WHEN NUMBERS MATTER MORE THAN SIZE

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Two elements of the Clean Air Act are viewed as essential to its many successes: the health-based national ambient air quality standards (NAAQS), which restrict emissions of six widely released air pollutants, and the statute's hybrid form of cooperative federal-state regulation. This Article will show that these programs are far less important to the operation of the statute than conventional wisdom would have you believe. An amalgam of parallel programs and external constraints, both political and practical, have marginalized the NAAQS framework and limited state action, such that in practice the law is more federal than it is cooperative.

Theories of environmental federalism have reinforced these misperceptions by focusing unduly on regulatory pathologies associated with large corporations (e.g., interstate regulatory races to the bottom, agency capture). While industrial sources are undoubtedly important, air pollution in the United States is largely a collective problem for which the number of sources matters more than their size. Environmental Protection Agency data show that urban density is the principal reason that almost 50 percent of Americans live in areas that fail to meet one or more NAAQS. The prevailing focus on emissions from large industrial facilities is misleading because it obscures many of the most important sources of air pollution and, perhaps more

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importantly, because it causes academics and policymakers to make assumptions about the political economy of clean air regulation that do not apply to the small, diffuse sources that account for most air pollution nationally.

Recognizing the structural limits and inconsistencies of clean air policy opens up significant opportunities for reform. First, EPA could be given the authority to set NAAQS compliance deadlines and to condition approval of state plans on adoption of specific programs. These reforms would refocus the planning process from meeting narrow bureaucratic ends to developing innovative programs and setting transparent compliance schedules. Second, federal regulation of major industrial sources skews regulatory priorities and unnecessarily limits state authority to select policies and allocate emissions across sources. I will argue that the two programs could be eliminated as part of compromise legislation to achieve broader reforms on issues such as climate change.

A vast literature exists on environmental federalism examining the appropriate balance of regulatory authority between the federal government and the states. The power of concentrated business interests to pressure government officials into relaxing environmental standards has long been a central focus of legal scholarship.[1] This perspective has been reinforced by writing on the political economy of environmental regulation, which is typically framed by public choice theory's narrative of agency capture by large regulated industries.[2]

This Article will show that, as an empirical matter, the prevailing focus on corporate power is misplaced. Industrial sources as a class rarely account for more than fifteen percent of the emissions of most air pollutants;[3] instead, diffuse sources in the transportation, residential, and small business sectors are

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1. *See, e.g.*, Richard B. Stewart, *Pyramids of Sacrifice? Problems of Federalism in Mandating State Implementations of National Environmental Policy*, 86 YALE L.J. 1196, 1210 (1977); Richard L. Revesz, *Rehabilitating Interstate Competition: Rethinking the "Race-to-the-Bottom Rationale for Federal Environmental Regulation*, 67 N.Y.U. L. Rev. 1210, 1222 (1992) [hereinafter Revesz, *Race-to-the-Bottom*]; Daniel C. Esty, *Revitalizing Environmental Federalism*, 95 MICH. L. REV. 570, 587 (1996).

2. *See, e.g.*, Richard L. Revesz, *Federalism and Environmental Regulation: A Public Choice Analysis*, 115 HARV. L. REV. 553, 555-56 (2001) [hereinafter Revesz, *Federalism and Environmental Regulation*] (describing the dominant view of environmental federalism as being grounded on the belief that "public choice pathologies cause environmental interests to be systematically underrepresented . . . relative to business interests"); Stewart, *supra* note 1, at 1215-16.

3. Other commentators have noted the importance of individual behavior as a major source of environmental harms; however, they have assumed incorrectly that this is a new phenomenon when, as shown below, it has been the norm from the start. *See, e.g.*, Michael P. Vandenbergh, *From Smokestack to SUV: The Individual as Regulatory Entity in the New Era of Environmental Law*, 57 VAND. L. REV. 515, 517-18 (2004).

the dominant contributors nationally.[4] Except for emissions from coal-fired power plants, air pollution is principally an urban problem for which the number of sources matters far more than their size.[5] Urban areas are home to 80 percent of the United States population,[6] and account disproportionately for the 50 percent of Americans who in 2005 lived in areas that failed to meet one or more national standards. They are also closely associated with high levels of toxic air pollution—the ten largest cities encompass 88 percent of the population exposed to the highest excess cancer risks nationally.[7]

The history of clean air policy reflects these patterns insofar as the strongest opposition to regulation has often involved the public rather than large industries. Experience implementing the Clean Air Act (CAA) in the 1970s illustrates the long-standing importance of small sources and public attitudes. The national ambient air quality standards (NAAQS), which established minimum health-based standards for six widely released "criteria" air pollutants, are viewed as the cornerstone of the statute.[8] Yet, it was evident from the start that emissions

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4. While the auto industry is clearly a "concentrated business interest," transportation planning and reducing vehicle miles traveled have been the most persistent obstacle to reducing emissions from the transportation sector. The barriers to these policies fall outside the dominant public choice model.

5. By the mid-1960s, air pollution was widely understood to be primarily an urban problem closely associated with emissions from motor vehicles. JAMES E. KRIER & EDMUND URSIN, POLLUTION AND POLICY: A CASE ESSAY ON CALIFORNIA AND FEDERAL EXPERIENCE WITH MOTOR VEHICLE AIR POLLUTION 1940-1975 202 (1977); Jeffrey Fromson, *A History of Federal Air Pollution Control*, 30 OHIO ST. L.J. 516, 535 (1969) (observing that "[i]n 1967 it was estimated that over 90 percent of the [air pollution] in Los Angeles was caused by motor vehicle emissions").

6. PAUL MACKUN & STEVEN WILSON, POPULATION DISTRIBUTION AND CHANGE: 2000 TO 2010, at 4 (2011), *available at* http://www.census.gov/prod/cen2010/briefs/c2010br-01.pdf.

7. The excess cancer risks in these cities were at least 100 times above the Clean Air Act's target risk level of one excess death per million. *See* 42 U.S.C. § 7412(f)(2) (2006).

8. Henry A. Waxman, *An Overview of the Clean Air Act Amendments of 1990*, 21 ENVTL. L. 1721, 1756 (1991) (describing the NAAQS as "the cornerstone of the CAA's pollution control programs"); ROBERT L. GLICKSMAN, ET AL., ENVIRONMENTAL PROTECTION: LAW AND POLICY 490-96, 514 (2011) (the "[t]he primary emphasis of the CAA is on the 'attainment' of these ambient

from older motor vehicles were the primary obstacle to states meeting the first NAAQS compliance deadline in 1975.[9] By mid-1973, the significance of this problem became clear when the Environmental Protection Agency (EPA) determined that at least ten major cities would have to ration gasoline.[10] These findings were particularly ill timed, as they coincided with the public outcry over the gas shortages triggered by the 1973 OPEC oil embargo.[11]

Public discontent boiled over later that year when, under court order, EPA issued a federal plan for California that required gas usage in Los Angeles to drop 82 percent during the smoggiest months.[12] EPA's plan was decried as absurd and met with utter disbelief by the public,[13] prompting even the Sierra Club to acknowledge that it was unrealistic.[14] To make matters worse, the court order binding EPA's actions was not limited to California—it applied to another nineteen cities, including New York, Philadelphia, and Houston.[15] Implementing such draconian measures ultimately proved to be a political non-

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standards"); Jamie Grodsky, *Genetics and Environmental Law: Redefining Public Health*, 93 CAL. L. REV. 171, 201 (2005) (describing the NAAQS program as "the heart of the Clean Air Act").

9. John Bachmann, *Will the Circle Be Unbroken: A History of the U.S. National Ambient Air Quality Standards*, 57 J. AIR WASTE MGMT. ASSOC. 652, 675 (2007) (stating that it "[i]t soon became clear that many states could not meet the 1975 attainment deadlines for all NAAQS"); John Quarles, *The Transportation Control Plans—Federal Regulation's Collision with Reality*, 2 HARV. ENVTL. L. REV. 241, 244 (1977) [hereinafter Quarles, *Transportation Control Plans*].

10. JOHN QUARLES, CLEANING UP AMERICA: AN INSIDER'S VIEW OF THE ENVIRONMENTAL PROTECTION AGENCY 203 (1976) [hereinafter QUARLES, CLEANING UP AMERICA]; KRIER & URSIN, *supra* note 5, at 223.

11. QUARLES, CLEANING UP AMERICA, *supra* note 10, at 203; KRIER & URSIN, *supra* note 5, at 223.

12. Bachmann, *supra* note 9, at 675; Quarles, *Transportation Control Plans*, *supra* note 9, at 244-48; KRIER & URSIN, *supra* note 5, at 221-23.

13. KRIER & URSIN, *supra* note 5, at 22-23, 239; QUARLES, CLEANING UP AMERICA, *supra* note 10, at 201-02.

14. KRIER & URSIN, *supra* note 5, at 22-23, 239 (noting that part of the Sierra Club's response to the debacle was to propose an emissions tax as an alternative measure).

15. KRIER & URSIN, *supra* note 5, at 216; QUARLES, CLEANING UP AMERICA, *supra* note 10, at 201-02.

starter, and Congress backpedalled by passing the first of several delays in the NAAQS compliance deadlines.[16]

One possible explanation for the focus on large industrial sources in the academic literature is the salience of anti-corporate sentiment in environmental politics. The public backlash against clean air policies in the 1970s exposed both the practical constraints to progress (i.e., the inertia of replacing older vehicles) and the political pitfalls of regulatory policies that directly impact the public. In this light, framing environmental policy around industrial sources has obvious virtues—the populist appeal of targeting large companies, the moral clarity of a narrative in which industry unilaterally harms the public, and the benefit of tapping into the enduring belief that industry is the primary cause of environmental problems. Further, by absolving the public of responsibility, this view mitigates the risk of inciting a public backlash similar to that experienced in the 1970s.

It is nevertheless surprising that academics have done little to challenge basic misperceptions about the relative importance of industrial sources, and that they frequently reinforce them.[17] Academic writing on environmental federalism, in particular, often assumes implicitly that industry is the primary obstacle to environmental regulation and that opposition from the public and small businesses is of marginal importance.[18] This Article will examine the influence of this industry-centric perspective on environmental policy and theories of federalism. It will focus on

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16. Quarles, *Transportation Control Plans*, *supra* note 9, at 249-51; Eli Chernow, *Implementing the Clean Air Act in Los Angeles: The Duty to Achieve the Impossible*, 4 ECOLOGY L.Q. 537, 551-53 (1974-75).

17. *See, e.g.*, Stewart, *supra* note 1, at 1215-16; Revesz, *Federalism and Environmental Regulation*, *supra* note 2, at 555-56; Esty, *supra* note 1, at 587; Kirsten H. Engel, *State Environmental Standard-Setting: Is There a "Race" and Is It "to-the-Bottom"?*, 48 HASTINGS L.J. 271, 275–76 (1996-1997); Jonathan B. Wiener, *On the Political Economy of Global Environmental Regulation*, 87 GEO, L.J. 749, 752-53 (1999); Peter P. Swire, *The Race to Laxity and the Race to Undesirability: Explaining Failures in Competition Among Jurisdictions in Environmental Law,* 14 YALE L. & POL'Y REV. 67 (1996).

18. *See, e.g.*, Stewart, *supra* note 1, at 1215-16; Revesz, *Federalism and Environmental Regulation*, *supra* note 2, at 555-56; Esty, *supra* note 1, at 587; Engel, *supra* note 17, at 275-76; Wiener, *supra* note 17, at 752-53; Swire, *supra* note 17.

experiences under the CAA, which established the model for cooperative federal-state regulation found in the major national environmental laws. In doing so, the Article will draw on a variety of historical sources and geospatial databases compiled by EPA.

The divergence between established views about cooperative federalism and its operation under the CAA illustrates the insights that emerge from an empirically grounded understanding of the law. A presumed virtue of cooperative federalism is that states make the difficult policy judgments regarding how to allocate emissions among sources. Cooperative federalism achieves this balance through a complementary division of authority between the federal government, which promulgates national standards, and the states, which determine how to meet them. Courts have interpreted this to mean that, while EPA retains oversight authority, states have complete discretion "to determine . . . the particular restrictions that will be imposed on particular emitters within their borders" so long as the national standards are met.[19]

The EPA data show that the CAA's system of cooperative federalism is undermined by legal and practical constraints on state programs. The overarching problem is a dearth of viable options available to states from which to select "particular restrictions" on air emissions.[20] Their authority to regulate emissions from motor vehicles, the largest source of emissions, is restricted in most states to transportation planning, which has evoked strong public opposition and had few successes.[21]

19. EME Homer City Generation v. Envtl. Prot. Agency, 696 F.3d 7, 12, 29-30 (D.C. Cir. 2012).

20. Emissions from natural sources or long-distance transport of pollutants that remain in the atmosphere for weeks or months further limit state options. Jed Anderson, *Revisiting the SIP Process: Finding a Better Approach to Cleaner Air*, 36 ST. B. TEX. ENVTL. L.J. 213, 214 (2005-2006) (noting that such background sources account for over 50 percent of the ozone pollution in the Dallas-Fort Worth area).

21. WINSTON HARRINGTON ET AL., RESOURCES FOR THE FUTURE, EXHAUSTING OPTIONS: ASSESSING SIP-CONFORMITY INTERACTIONS 18, 33 (2003) (finding that public opposition is "still strong" to the most promising methods (e.g., gasoline taxes, congestion fees) for reducing emissions from motor vehicles), *available at* http://www.rff.org/rff/documents/rff-rpt-exhaustopt.pdf;

Similarly, regulation of small stationary sources,[22] which account for most of the remaining emissions, is impeded by political and administrative barriers that have stalled regulation for decades.[23] The constraints on state programs are also greatest in large metropolitan areas where air quality is lowest.

By contrast the barriers are lower for direct federal regulations, which according to recent empirical studies are the primary driver of reductions in air pollutants under the CAA. The success of federal regulations is attributable to two simple facts—federal regulations cover a large share of total air emissions, and they regulate sources that are *relatively* easy to control. In every state except California, EPA has had preemptive authority to regulate emissions from motor vehicles since 1967, and beginning in 1990 it gained primary authority over regulation of emissions from electric utilities.[24] To put this in perspective, these source categories account for roughly 40 to 90 percent of each criteria pollutant's emissions nationally.[25]

Penny Mintz, *Transportation Alternatives Within the Clean Air Act: A History of Congressional Failure to Effectuate and Recommendations for the Future*, 3 N.Y.U. ENVTL. L.J. 156, 167, 191-92 (1994-95); Tirza S. Wahrman, *Breaking the Logjam: The Peak Pricing of Congested Urban Roadways Under the Clean Air Act to Improve Air Quality and Reduce Vehicle Miles Traveled*, 8 DUKE ENVTL. L. & POL'Y F. 181, 189-92 (1997-98); Craig Oren, *Getting Commuters Out of Their Cars: What Went Wrong*, 17 STAN. ENVTL. L.J. 141, 143-47 (1998).

22. EPA refers to these sources as either "area" or "nonpoint" sources. Examples of nonpoint sources include gas stations, paint emissions, restaurants, and agricultural field burning.

23. *See infra* Part II.B.

24. New or modified industrial sources are subject to strict federal technology-based regulations. New Source Performance Standards (NSPS), which are technology-based performance standards, operate as minimum standards that major sources of criteria pollutants are required to meet. At the same time, NSR offsets and emissions limits under the Prevention of Significant Deterioration program add further restrictions for nonattainment and attainment areas, respectively. 42 U.S.C. §§ 7411, 7470-79, 7503, 7511(C)(4) (2006).

25. *See infra* Part IIIA. Motor vehicles and electric utilities account for 82 percent of nitrogen oxides emitted, 91 percent of sulfur dioxide, 76 percent of carbon monoxide, and 38 percent of volatile organic compounds (small stationary sources accounted for 54 percent of its emissions) in 2005. The sole exception to this dominance is small particulate matter ($PM_{2.5}$), for which motor vehicles and electric utilities accounted for only about 20 percent of its emissions.

Despite these realities, academics, judges, and stakeholders routinely describe the CAA as a model of cooperative federalism.[26] The schism between such broadly held beliefs and the realities on the ground illustrates the urgent need for more empirical studies of environmental laws in practice. Many academic debates focus on first principles, such as the relative merits of pure health-based standards versus balancing regulatory costs and benefits, without considering the effects of overlapping programs or systemic constraints. Political or ideological battles can reinforce these tendencies. Academics are notably silent, for example, about carve-outs in the NAAQS—putatively national standards that afford multi-decade exemptions in areas with the worst air quality—and the daunting practical barriers to meeting them.[27]

Recognizing the structural limits and inconsistencies of clean air policy opens up significant opportunities for reform, two of which will be outlined below as illustrative examples. First, the CAA's system of cooperative federalism will continue to underperform unless it stimulates development of effective state and local policies for regulating smaller sources. EPA could be given the authority to set NAAQS compliance deadlines and to condition approval of state plans on adoption of specific programs. These reforms would refocus the planning process

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26. *See, e.g.*, Holly Doremus & W. Michael Hanemann, *Of Babies and Bathwater: Why the Clean Air Act's Cooperative Federalism Framework is Useful for Addressing Climate Change*, 50 ARIZ. L. REV. 799, 800, 817 (2008) (citing the CAA as a model for cooperative federalism); Jessica Bulman-Pozen & Heather K. Gerken, *Uncooperative Federalism*, 118 YALE L.J. 1256, 1276 (2009) (using the CAA as the exemplar of cooperative federalism in environmental law); *Clean Air Act Forums: State, Local, and Federal Cooperation Under the Clean Air Act Before Subcomm. on Energy and Power of the House Comm. on Energy and Commerce*, 112th Cong. 9 (2012) (statement of Barry R. Wallerstein, Executive Officer, South Coast Air Quality Management District, asserting that the CAA "has worked very well as a model of cooperative federalism"); GenOn REMA v. Envtl. Prot. Agency, 722 F.3d 513, 516 (3d Cir. 1213) (describing cooperative federalism as a "defining feature" of the CAA); Ellis v. Gallatin Steel Co., 390 F.3d 461, 467 (6th Cir. 2004) (describing the CAA as "a model of cooperative federalism").

27. *But c.f.* David Harrison, Jr. & Paul R. Portney, *Making Ready for the Clean Air Act*, 5 REG. 24, 26 (1981) (observing that "the current 'uniform' standards are not really uniform at all . . . . [g]iven both de jure and de facto departures from uniformity").

from meeting narrow bureaucratic ends to developing innovative programs and transparent compliance schedules. Second, federal regulation of major industrial sources skews regulatory priorities and unnecessarily limits state authority to select policies and allocate emissions across sources. I will argue that the two programs could be eliminated as part of compromise legislation to achieve broader reforms on issues such as climate change. This would represent a dramatic concession by environmentalists, but could be implemented without negatively affecting human health. While I appreciate that this proposal cuts against deeply held views, significant legislative action is far less likely to occur if we fail to reconsider established beliefs or to exploit opportunities for compromise.

The Article proceeds in four parts. Part I presents an overview of clean air policy in the United States that challenges contemporary views about federalism and the role of business interests in environmental politics. Part II analyzes EPA data on air emissions and excess cancer risks to show empirically the importance of small sources and the origins of the systemic barriers to state clean air programs. Part III examines the implications of the findings in the preceding sections for environmental federalism, focusing on the limits of cooperative federalism and deviations from public choice theory. The number and diffuse nature of small sources are shown to qualify the conventional arguments for federal regulation, but the specific balance federal and state regulation will depend on the characteristics of the relevant sources. The findings are applicable to any area of environmental policy, including climate change mitigation,[28] for which small sources are important. The final section, Part IV, examines two potential opportunities for reform that follow from the empirical results and an ecumenical view of environmental federalism.

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28. JON CREYTS ET AL., REDUCING U.S. GREENHOUSE GAS EMISSIONS: HOW MUCH AT WHAT COST? xii (2009) (stating that "abatement options [for reducing GHG emissions] are highly fragmented and spread across the [U.S.] economy"), http://www.mckinsey.com/client_service/sustainability/latest_thinking/greenhouse_gas_abatement_cost_curves.

I.
THE PRESSURES TO FEDERALIZE CLEAN AIR POLICY

The history of clean air legislation provides a valuable perspective for critically analyzing contemporary policy debates. Three recurrent patterns standout in the narrative: (1) the emergence of innovative policies in localities with the worst air pollution; (2) the consistent dominance of emissions from small sources (i.e., motor vehicles, small businesses, residences); and (3) the prevalence of concerns that policies would disparately impact economic development in certain states or localities (e.g., urban versus rural areas). Experience implementing the CAA negates the conventional view that environmental politics is defined predominantly by conflicts with concentrated business interests. In practice, the political economy of clean air regulation is not nearly so one sided; to the contrary, opposition from the public and small businesses has frequently been a greater barrier to clean air policies than industry lobbying.

At the outset, it is important to understand that severe air pollution almost invariably involves a confluence of adverse meteorological conditions and large numbers of sources concentrated in discrete areas.[29] The worst air quality is found in urban areas and is closely tied to emissions from motor vehicles or the burning of coal.[30] Historically, the most severe events have involved stagnant air conditions that trap pollutants at ground level,[31] topography that impedes their lateral diffusion, or both.[32] From the 1940s to the 1960s, extreme pollution events in Donora (Pennsylvania), London, Los Angeles, and New York caused tens of thousands of deaths, and each event was precipitated by

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29. J. CLARENCE DAVIES, THE POLITICS OF POLLUTION 35-36 (1975) (noting that temperature inversions occurred on the east coast 10-30% of the time and on the west coast 35-40% of the time).

30. H.R. Anderson, *Air Pollution and Mortality: A History*, 43 ATMOSPHERIC ENV'T 142, 143 (2009).

31. COUNCIL ON ENVIRONMENTAL QUALITY, ENVIRONMENTAL QUALITY, SECOND ANNUAL REPORT 217 (August 1971); Anderson, *supra* note 30, at 143 (observing that London, Meuse, Donora, Los Angeles all suffered from severe temperature inversions during the winters of their worst smog events).

32. Anderson, *supra* note 30, at 145.

adverse meteorological conditions.[33]

Air pollution policy in the United States is separable into two distinct periods. The era of "smoke," which spanned the mid-1800s through the late 1940s and was associated with the use of coal for heating or power;[34] and the era of "photochemical smog," which began in the 1940s and continues through today and is largely associated with emissions from motor vehicles. We are arguably entering a third era that is likely to be dominated by regulation of greenhouse-gas emissions. During the smoke era, severe pollution, on a par with that in Beijing today, pervaded major U.S. cities such as Chicago, Pittsburgh, and St. Louis.[35] Municipalities were the locus of regulation throughout this period,[36] and cities like St. Louis, which had the first successful smoke abatement program, became models for the rest of the country.[37]

Regulation during the smoke era relied heavily on switching to cleaner-burning fuels rather than emissions control technologies.[38] By the mid-1940s, natural gas began to replace coal as the primary fuel for residential heating and commercial systems, and diesel became the predominant fuel for trains.[39] These transitions were essential to the dramatic gains in the 1940s and 1950s, which cleared the air after decades of suffering

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33. KRIER & URSIN, *supra* note 5, at 104-06, 171, 264-65 (describing the pollution events in Los Angeles, London, and New York).

34. JOEL A. TARR, THE SEARCH FOR THE ULTIMATE SINK: URBAN POLLUTION IN HISTORICAL PERSPECTIVE 14 (1996) (describing smoke from coal burning as an urban residential problem compounded by industry and transportation).

35. *Id.* at 219 ("Severe smoke pollution persisted in American cities such as Chicago, Pittsburgh, and St. Louis for nearly a century, defying attempts at a solution.").

36. DAVID STRADLING, SMOKESTACKS AND PROGRESSIVES: ENVIRONMENTALISTS, ENGINEERS, AND AIR QUALITY IN AMERICA, 1881-1951 71, 75, 164-65, 167-71 (1999) (noting that the St. Louis "Clean Fuels" ordinance of 1939 led to an 84% drop in hours of thick smoke); TARR, *supra* note 34, at 234-36, 249-50.

37. STRADLING, *supra* note 36, at 71, 75; FRANK UEKOETTER, THE AGE OF SMOKE: ENVIRONMENTAL POLICY IN GERMANY AND THE UNITED STATES, 1880-1970 85, 118 (2009) (observing that St. Louis and Pittsburgh were the smoke-abatement "models for the country").

38. STRADLING, *supra* note 36, at 167-71.

39. TARR, *supra* note 34, at 17-18.

in just a few years.[40] The improvements in air quality also greatly enhanced the status of municipal agencies and prolonged their dominance in clean air policy through the early 1960s.[41]

The smog era initiated a radical move from local policies to federal legislation. The populist politics of clean air policy nevertheless persisted despite the differences in sources and pollutants. The reform movements in both eras focused initially on large industries, owing to their visibility and association with pollution, whereas the importance of smaller sources was controversial and recognized only after regulation of industrial sources failed to reduce pollution levels.[42] Public debate also followed a progression from activism based on moral principles to a focus on technology and economics,[43] and this shift led to the establishment of independent institutes to assess emerging scientific results and prominent roles for technical experts.[44] The diffuse origins of air pollution, and particularly their failure to fit a simple narrative of industry unilaterally harming the general public, facilitated this progression in both eras.

The emergence of smog was a byproduct of the post-war economic boom and the rapid urbanization that followed. Motor vehicles replaced coal burning as the primary cause of poor air quality, and coal use migrated from trains and diffuse residential sources to huge electric utilities. The geographic scale and nature of air pollution changed as a consequence, placing

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40. STRADLING, *supra* note 36, at 167-71, 182, 189.

41. UEKOETTER, *supra* note 37, at 86, 152-153 (quoting the Council of State Governments as stating in 1967 that "Local government . . . are the leaders in air pollution control efforts"). In fact, states were often uninterested in urban problems with air pollution because of the political power of rural interest groups. *Id.* at 150.

42. *Id.* at 39 (describing the municipal reform efforts in the late 1800s that began with campaigns against industry); TARR, *supra* note 34, at 15, 231, 238 (noting that "domestic smoke was dirtier and far more harmful than industrial smoke" and that early ordinances nevertheless focused on industrial and transportation sources).

43. STRADLING, *supra* note 36, at 42, 59, 86-87, 101-02, 106-08, 136-38 (describing the increased focus on economics as a rationale for guiding policy decisions).

44. STRADLING, *supra* note 36, at 98-100. In St. Louis, for example, the Smoke Abatement League conducted its own investigations and made citizens arrests. *Id.* at 54-55.

new strains on local governments that were often poorly suited to manage them. Los Angeles, and later California as a whole, was at the forefront of this transformation and the early development of smog abatement policies. The discussion that follows begins with Los Angeles because its regulations were the starting point for modern clean air policy in the United States.

A. California as a Policy Incubator

Los Angeles was the fastest growing metropolitan area in the country following the Second World War, and this growth owed much to the popular images of its ideal climate and healthy environment.[45] The occurrence of severe smog events in the 1940s thus represented a dramatic change that threatened "the very foundations of the city's existence."[46] Together, adverse local meteorology and rapid post-war development conspired to make Los Angeles an unique laboratory for developing the scientific understanding of urban air pollution and model policies for combatting it.[47]

The local politics in Los Angeles followed the trajectory of policy debates during the smoke era. Public organizers and city officials focused initially on large industrial sources, and only after years of worsening conditions were they persuaded that motor vehicles were the primary source of photochemical smog.[48] Initial responses were limited to establishing a countywide air pollution control district and issuing technology-based standards

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45. SCOTT H. DEWEY, DON'T BREATH THE AIR: AIR POLLUTION AND U.S. ENVIRONMENTAL POLITICS, 1945-1970 37-38 (2000); UEKOETTER, *supra* note 37, at 198-99 (describing Los Angeles as a "healthful land and a tourist paradise").

46. UEKOETTER, *supra* note 37, 198-99. Pollution events in the 1950s and 60s led to continued public activism and support from the Chamber of Commerce for effective regulations. Dewey, *supra* note 45, at 94-97.

47. DEWEY, *supra* note 45, at 37-38; KRIER & URSIN, *supra* note 5, at 42-45 (description of the meteorological and topographic factors that greatly exacerbate air pollution in Los Angeles).

48. DEWEY, *supra* note 45, at 40, 108-09 (observing that public criticism of emissions from industrial facilities persisted into the 1960s despite the contrary science); KRIER & URSIN, *supra* note 5, at 58, 74 (noting that Los Angeles city officials often stated that motor vehicles were "relatively minor" sources of air pollution).

for prominent industrial sources.[49] Predictably, these early efforts did little to prevent conditions from deteriorating. Los Angeles was already the driving capital of the world by the end of the 1940s[50]—the metropolitan area had 50 percent more vehicles than New York City and greater numbers than countries other than Britain, Canada, and France.[51]

Two events redirected attention to motor vehicles. First, the coincidence in November 1949 of a severe inversion and a maximum-capacity football game in Berkeley provided a vivid example of the link between air pollution and motor vehicles.[52] Second, Dr. Arie Haagen-Smit, a professor at the California Institute of Technology, published experimental results demonstrating the link between motor vehicle emissions and smog.[53] Similar to today with climate change, scientific consensus on Dr. Haagen-Smit's findings arose quickly, solidifying by 1955, while public acceptance ebbed and flowed over a much longer period.[54] The work of the independent Air Pollution Foundation, which was established by a coalition of businessmen, civic leaders, and government officials, was ultimately critical to shifting public opinion.[55]

Los Angeles made little progress during the 1950s despite the scientific advances owing to a combination of technological barriers and jurisdictional fragmentation.[56] This failure and

49. DEWEY, *supra* note 45, at 42; UEKOETTER, *supra* note 37, at 160 (noting that governments officials "had no choice but to take technological possibilities as their starting point" due to limited knowledge of the risks); KRIER & URSIN, *supra* note 5, at 60-61, 66 (Los Angeles imposed technology-based standards on new or modified sources "wherever there is a way to control it, it must be controlled to the limits of present-day engineering knowledge").

50. KRIER & URSIN, *supra* note 5, at 71-72.

51. DEWEY, *supra* note 45, at 58.

52. DEWEY, *supra* note 45, at 47-48; KRIER & URSIN, *supra* note 5, at 75-76].

53. DEWEY, *supra* note 45, at 47-48; KRIER & URSIN, *supra* note 5, at 75-76.

54. DEWEY, *supra* note 45, at 49; KRIER & URSIN, *supra* note 5, at 6, 80 (discussing early public skepticism that the science were merely a "conspiracy by the 'interests' to blame smog problems on innocent citizens"); UEKOETTER, *supra* note 37, at 206 (discussing the resistance of the auto industry into the 1960s).

55. KRIER & URSIN, *supra* note 5, at 84-85.

56. KRIER & URSIN, *supra* note 5, at 98. During the mid-1950s, there were intense debates over threshold for proving harm that would justify regulation

rising public concern prompted state intervention in 1960. Passage of the California Motor Vehicle Pollution Control Act established the first statewide Board with the authority to set emissions standards, in this case for new and used vehicles.[57] The Board issued its first standards in 1961 for new vehicles without significant public opposition.[58] However, its carefully phased-in standards for used vehicles triggered an enormous public outcry that led to their withdrawal in 1965.[59] This experience had major ramifications, as it effectively foreclosed subsequent consideration of regulations for used vehicles. The controversy was also a harbinger of the public backlashes against transportation regulations that erupted in the early 1970s and 1990s.[60]

Despite his free-market beliefs, Governor Ronald Reagan oversaw a dramatic expansion of state clean air regulations in 1967. The law extended state regulation to stationary sources, divided the state into air basins, and centralized state-level regulatory authority in the California Air Resources Board (CARB).[61] These measures co-evolved with the legal framework of the CAA, including its system of cooperative federalism. Using an analogous division of authority, CARB set state ambient air quality standards while local governments implemented them and had the freedom to set more stringent standards.[62] Local governments also retained the authority to regulate stationary sources, whereas CARB could intervene only if local programs

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and over the use of cost-benefit analysis. *Id.* at 120-22.

57. DEWEY, *supra* note 45, at 64.

58. KRIER & URSIN, *supra* note 5, at 152-53.

59. *Id.*; DEWEY, *supra* note 45, at 102-03 (describing the mishandling that led to the overwhelming public opposition).

60. CHARLES O. JONES, CLEAN AIR: THE POLICIES AND POLITICS OF POLLUTION CONTROL 66 (1975) (describing how the auto industry subjected California regulations to "the most unbelievable" opposition); UEKOETTER, *supra* note 37, at 210 (noting that the relationship between Los Angeles officials and car companies began well but collapsed into disillusionment by August 1956).

61. DEWEY, *supra* note 45, at 73; KRIER & URSIN, *supra* note 5, at 178-79.

62. KRIER & URSIN, *supra* note 5, at 178-79. This framework was dictated in part by constitutional limits on state regulatory authority vis-a-vis municipalities and counties. *Id.*

failed to meet state standards.[63]

The policy developments in California did not occur in isolation. Many large urban areas were suffering from severe air pollution by the 1960s,[64] and local governments elsewhere were beginning to take action.[65] Local regulation in other states tended to be weak, though. Unlike California—where severe air pollution was a pervasive problem—local regulation was often constrained by state politics that were dominated by rural interests.[66] Further, the viability of local regulation was in decline following the rapid suburbanization of the 1950s and 1960s. The resulting expansion of urban boundaries greatly exacerbated mismatches between the geographic scale of air pollution and the jurisdiction of local agencies.[67]

In retrospect the 1960s was a transitional period marked by emerging federal action and debate over the balance of authority between federal and state programs. Congress began by enacting a series of laws to support state clean air programs, but by 1965 took the unprecedented step of regulating emissions from motor vehicles directly. Although California congressmen succeeded in preserving the state's regulatory authority under the new law,[68] the trend by the late 1960s was clearly toward enhanced federal oversight and direct regulation.

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63. *Id.*

64. *Id.* at 41; Davies, *supra* note 29, at 134-35; Uekoetter, *supra* note 37, at 154.

65. U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, STATE AND LOCAL PROGRAMS IN AIR POLLUTION CONTROL 112-13, 115-17, 120 (1966) (describing a series of leading state programs in the 1960s).

66. UEKOETTER, *supra* note 37, at 150 (observing "state legislatures showing little concern due to the predominance of rural interests"); JONES, *supra* note 60, at 50 (describing how support for effective air regulations was stronger at the municipal level in Pennsylvania).

67. UEKOETTER, *supra* note 37, at 150-51, 178 (describing the "crisis of municipal air pollution control" that emerged in the 1950s after the successes of the anti-smoke initiatives).

68. JONES, *supra* note 60, at 83-84 (noting that California retained the authority to set standards more stringently than those of the federal government); DAVIES, *supra* note 29, at 57-58.

B. The Punctuated Evolution of Federal Clean Air Policy

Political support for federal action on clean air policy was primarily sparked by concerns about emissions from motor vehicles, as opposed to fears about industrial sources. National awareness established a foothold following the release of a 1962 Surgeon General's report that confirmed the close association between poor air quality and motor-vehicle emissions.[69] This foothold was solidified by 1969 when a Senate Commerce Committee report concluded, "[t]he automobile is the primary villain in air pollution."[70] The politically salient effects were associated with increasingly severe pollution events in urban areas,[71] which showed that Los Angeles was not a unique case, but instead an extreme example of a systemic problem.[72]

The legal framework for the CAA emerged incrementally over roughly a fifteen-year period during which clean air politics shifted from a focus on motor vehicles to one on large industrial sources. The first phase, dating back to the Clean Air Act of 1963, established the federal government as a clearinghouse for scientific information.[73] Consistent with the "states' rights" beliefs that prevailed through the early 1960s, the federal government was limited to providing technical and financial support to the states. This step was significant because it began the process of carving out a role for the federal government by requiring it to issue the technical "criteria" that each state would

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69. JONES, *supra* note 60, at 62-63; Dewey, *supra* note 45, at 75 (Congress acknowledged that autos were "responsible for 50% of the national air pollution problem"). Policymakers and experts also understood by this time that "the major sources [of smog] were everyday activities of the public, not industrial operations." KRIER & URSIN, *supra* note 5, at 91

70. KRIER & URSIN, *supra* note 5, at 202; *see also* Fromson, *supra* note 5, at 535 (observing that "[i]n 1967 it was estimated that over 90 percent of the [air pollution] in Los Angeles was caused by motor vehicle emissions").

71. DAVIES, *supra* note 29, at 134-35. Air pollution in interstate urban centers, in particular, was proving to be intractable for state regulators and provided a compelling case for federal action. *Id.* at 134-35; *see also* UEKOETTER, *supra* note 37, at 154.

72. Edmund S. Muskie, *The Clean Air Act: A Commitment to Public Health*, ENVTL. F. 13, 13 (Jan.-Feb. 1990); KRIER & URSIN, *supra* note 5, at 41.

73. DAVIES, *supra* note 29, at 165.

use to set ambient air quality standards.[74]

Just two years later, the federal government advanced to regulating emissions from motor vehicles under the Motor Vehicle Pollution Control Act (MVPCA), mirroring earlier developments in California. Beyond the importance of their emissions, motor vehicles were an attractive regulatory target politically because their interstate movement and national market defused concerns about states' rights. The law evoked strong criticism, though, for failing to be explicit about whether it preempted state regulation.[75] Under intense pressure from escalating public concern about air pollution and auto industry objections to conflicting state standards,[76] Congress passed the 1967 Federal Air Quality Act. The new law resolved the preemptive effect of the MVPCA (with the California exemption intact) and added new layers of federal oversight, most importantly federal approval of state ambient air quality standards and state plans for implementing them, but was burdened by onerous procedural requirements.[77]

The pivotal 1970 Clean Air Act added the final elements of the statute's framework for cooperative federalism and established breathtakingly ambitious goals.[78] The standards for new motor vehicles, which required roughly a 90 percent reduction in emissions by 1975, were the most hotly contested provisions.[79] Structurally, the new law created the NAAQS, with strict

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74. JONES, *supra* note 60, at 74-76. Although toothless, the 1963 CAA included a provision for "federal abatement" of air pollution when human health or welfare were "endangered"; this authority was never exercised. *Id.*

75. BACHMANN, *supra* note 9, at 663.

76. Davies, *supra* note 29, at 53-54 (discussing the more than 100 clean air bills that were pending nationally in 1967); KRIER & URSIN, *supra* note 5, at 174.

77. DAVIES, *supra* note 29, at 57-58; JONES, *supra* note 60, at 83.

78. Richard J. Lazarus, *The Tragedy of Distrust in the Implementation of Federal Environmental Law*, 54 L. & CONTEMP. PROBS. 311, 324-5 (1991) (describing the numerous deadlines under the 1970 CAA as being highly ambitious if not completely unrealistic).

79. The new standards required a 90 percent reduction in the emissions of key pollutants from motor vehicles by January 1975. KRIER & URSIN, *supra* note 5, at 206, 208 (noting that regulatory standards were taken from a 1970 report prepared by the National Air Pollution Control Administration using very conservative assumptions).

compliance deadlines for listed "criteria pollutants,"[80] and a cooperative division of authority between the federal government and the states.[81] Adoption of national standards, however, was not a foregone conclusion. They had been debated extensively but rejected in 1967,[82] while the leading proponent of clean air legislation, Senator Edmund Muskie, had opposed national standards based on fears that disparate local conditions would make them inefficient if not unworkable.[83] Presidential politics would later encourage Senator Muskie to reverse his position during an ultimately unsuccessful run for the highest office.[84]

National standards also created politically divisive issues of their own. The heterogeneity of air quality across the country—most importantly between rural and urban areas—implied that jurisdictions with poor air quality would be required to subject sources to stringent emissions limits.[85] State and local officials argued that national standards would put urban areas at a competitive disadvantage and opposed them.[86] Congress addressed these concerns by adding another layer of regulation: "New Source Performance Standards" (NSPS), which set minimum technology-based standards for significant new

80. The six air pollutants regulated under the NAAQS program are referred to as "criteria pollutants." BACHMANN, *supra* note 9, at 671.

81. 42 U.S.C. § 7409(b) (2006).

82. JONES, *supra* note 60, at 79-80; BACHMANN, *supra* note 9, at 664 (noting that the Johnson Administration believed national standards would "avoid placing industries at a competitive disadvantage").

83. JONES, *supra* note 60, at 79-82; BACHMANN, *supra* note 9, at 664. Other commentators viewed "the process of defining air basins or AQCRs [as] a 'pointless charade'" due to the inadequacies of emissions inventories and the limitations in modeling capabilities; they endorsed technology-based approaches before modeling. BACHMANN, *supra* note 9, at 665-66.

84. JONES, *supra* note 60, at 179-81, 195; KRIER & URSIN, *supra* note 5, at 201-03; STRADLING, *supra* note 36, at 30 (urban communities feared that regulations would "prevent industry from locating in their cities or force existing industries to [leave]").

85. BACHMANN, *supra* note 9, at 664 (describing how one of the Johnson's Administration's "policy goals was to ensure that industry in cleaner areas did not have an advantage over those in dirtier areas").

86. DAVIES, *supra* note 29, at 134; TARR, *supra* note 34, at 370 (noting that in 1935 the National Resource Committee found that lack of uniformity of regulations led to unfair competition between states for industry).

industrial sources independently of local air quality.[87] The floor they provided was designed to mitigate disparities in emissions limits between localities, and thus to level the regulatory playing field.[88]

Congress' decision to set aggressive compliance deadlines for the NAAQS became a defining feature of the 1970 Amendments. This mandate was integral to the "action forcing" philosophy of the time, and key congressional members understood the implications of the short deadlines and basing the NAAQS solely on protecting "human health and welfare." The legislative report of the Senate Committee on Public Works estimated that "as much as *seventy-five percent* of the traffic may have to be restricted in certain large metropolitan areas if health standards are to be achieved within the time required by this bill."[89] Restrictions of this magnitude were unavoidable because the CAA's motor vehicle standards applied only to new vehicles, and thus would not significantly impact air pollution for more than a decade.[90]

It did not take long for the statute's bold objectives to run up against political realities and deteriorating global economics. The energy crisis of the 1970s sapped political support for aggressive environmental policies and spurred Congress to pass legislation in 1974 to slow the phase-in of controls on vehicle emissions.[91] More ominously, at a time when Americans were reeling from gas shortages associated with the 1973 OPEC oil embargo, EPA's analyses concluded that thirty-eight cities would require aggressive transportation control plans and that at least ten would have to institute gasoline rationing.[92]

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87. 42 U.S.C. § 7411 (2006).

88. W. Perry Pendley & J. Michael Morgan, *The Clean Air Act Amendments of 1977: A Selective Legislative Analysis*, 12 LAND & WATER L. REV. 747, 785 (1978) (describing Congress's intent that NSPS would "plac[e] all states on an equal footing in their efforts to attract industry and control development").

89. S. Rep. No. 91-1196, at 2 (1970) (emphasis added).

90. *Id.*; QUARLES, CLEANING UP AMERICA, *supra* note 10, at 193, 201.

91. QUARLES, CLEANING UP AMERICA *supra* note 10, at 193, 207, 210; JOHN C. WHITAKER, STRIKING A BALANCE: ENVIRONMENT AND NATURAL RESOURCES POLICY IN THE NIXON-FORD YEARS 102, 110 (1976) (noting that Congress also enacted measures to promote a shift to coal in the electric utility sector).

92. QUARLES, CLEANING UP AMERICA, *supra* note 10, at 203; KRIER & URSIN,

California became the epicenter of rising public opposition to national standards in large part because of the severity of its problems. The impossibility of meeting the NAAQS in Los Angeles led to several failed attempts to craft a workable state plan; unsurprisingly, all were doomed by the inadequacies of their transportation control measures.[93] EPA rejected California's state plan in 1972 and, under court order, issued a federal plan in 1973.[94] The national standards left no other choice, and the implications for Los Angeles were stunning—EPA's plan required gas usage to drop by 82 percent from May through October, along with parking restrictions, tolls, and vehicle inspection and maintenance programs.[95]

The public outcry was overwhelming. EPA's plan was derided as "absurd" and met with "utter disbelief" by the public,[96] relatively modest programs, such as parking surcharges, were also fiercely opposed and ultimately withdrawn from subsequent state plans, which left the Los Angeles area without either a state or federal plan for more than two decades.[97] These responses revealed a far less progressive side of the public's interests and the populist limits of clean air policy.

The relationship between federal and state officials also shifted following passage of the 1970 CAA.[98] Ironically, the

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supra note 5, at 223.

93. Alan C. Waltner, *Paradise Delayed – The Continuing Saga of the Los Angeles Clean Air Implementation Plan*, 14 UCLA J. Envtl. L. & Pol'y 247, 248-49 (1996). An important element of this was states' failure to impose indirect source controls (e.g., highways, shopping malls) associated with urban growth. *See* Patrick Del Duca & Daniel Mansueto, *Indirect Source Controls: An Intersection of Air Quality Management and Land Use Regulation*, 24 LOY. L.A. L. REV. 1131, 1149-54 (1991).

94. KRIER & URSIN, *supra* note 5, at 221; QUARLES, CLEANING UP AMERICA, *supra* note 10, at 201-02.

95. JONES, *supra* note 60, at 270-71; QUARLES, CLEANING UP AMERICA, *supra* note 10, at 202. Moreover, the court order binding EPA's actions was not limited to California—it applied to another nineteen cities, including New York, Philadelphia, Houston, and Dallas. KRIER & URSIN, *supra* note 5, at 216.

96. QUARLES, CLEANING UP AMERICA, *supra* note 10, at 201-02.

97. KRIER & URSIN, *supra* note 5, at 228-29; QUARLES, CLEANING UP AMERICA, *supra* note 10, at 203; Del Duca & Mansueto, *supra* note 93, at 1140-41.

98. JONES, *supra* note 60, at 68.

change was most pronounced in California despite its longstanding leadership on clean air policy and the widespread extent of air pollution in the state. By June 1971, Dr. Haagen-Smit, who was the head of CARB and had pioneered the scientific work on smog, concluded that "some aspects of the federal regulations were unachievable."[99] His reservations were borne out by EPA estimates that it would take at least twenty years for Los Angeles to comply with the NAAQS.[100] Further, it was a California lawsuit that would narrow EPA's oversight authority and drastically limit the agency's capacity to promote meaningful transportation control measures.[101]

C. Political Compromise and Federal Expansion

The enormous public opposition EPA encountered in the early 1970s prompted a series of retrenchments, which began with extensions of compliance deadlines but later included more fundamental changes. The political compromise that emerged from these setbacks retained putatively national standards, but did so by, in effect, trading space for time through a system of delayed compliance dates for jurisdictions with the worst air quality.[102] This strategy retained the moral appeal of the NAAQS, which remained nominally health-based, while avoiding the public backlash from imposing draconian restrictions on driving in major urban centers.

The 1977 Amendments to the CAA represented the first concerted effort by Congress to address the shortcomings of the statute. The changes were prompted by technological problems

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99. KRIER & URSIN, *supra* note 5, at 210-12.

100. KRIER & URSIN, *supra* note 5, at 213.

101. *Id.* at 169-75 (concluding that *Brown v. EPA* and other cases "eliminated EPA's ability to apply sanctions to force states to . . . spend tax dollars regulating traffic . . . . leav[ing] a yawning breach in the [CAA]").

102. In one of the most detailed accounts of EPA's implementation of the CAA in the 1970s, Shep Melnick describes this as a "conscious political strategy [to] bend on deadlines, but never on goals; keep goals out of reach to put constant pressure on regulators and polluters. Relaxing goals would not only weaken the technology-forcing thrust of the Clean Air Act, but would signal a general retreat from environmental protection." R. SHEP MELNICK, REGULATION AND THE COURTS: THE CASE OF THE CLEAN AIR ACT 363 (1983).

with meeting the emissions standards for motor vehicles, the need to delay further the NAAQS compliance deadlines, and conflicts that had emerged over emissions from coal-fired power plants.[103] Against the backdrop of the 1970s energy crisis, the pressure to delay the NAAQS compliance deadlines and motor vehicle standards was intense.[104] As a result, the decision by Congress to push back the compliance dates involved a long and contentious bargaining process but was ultimately a foregone conclusion.[105]

The most significant amendments in 1977 concerned parallel regulations of major industrial sources.[106] The disputes centered on emissions from coal-fired power plants in rural areas, particularly around national parks, and efforts by congressional members to protect the interests of eastern coal companies.[107] The battle over rural air quality revived concerns about maintaining a level regulatory playing field across states.[108] In

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103. RICHARD H.K. VIETOR, ENVIRONMENTAL POLITICS AND THE COAL COALITION 208- 209, 214, 218 (1980).

104. QUARLES, CLEANING UP AMERICA, *supra* note 10, at 206-07; *see also* Bruce Karmer, *The 1977 Clean Air Act Amendments: A Tactical Retreat from the Technology-Forcing Strategy?*, 15 URB. L. ANNUAL 103, 121-22 (1978) (describing the extensions for NAAQS to 1982 and, in the case of CO and ozone, until as late as 1987).

105. Pete Domenici, *Clean Air Act Amendments of 1977*, 19 NAT. RESOURCES J. 475, 483 (1979).

106. There were significant amendments relating to mobile sources as well, most notably limits on EPA regulating "indirect" sources of air pollution (e.g., shopping malls or sports stadiums that would increase traffic) and provisions attempting to clarify that the CAA does not "infringe[] on . . . or transfer[] . . . the existing authority of countries and cities to plan or control land use." Del Duca & Mansueto, *supra* note 93, at 1155.

107. VIETOR, *supra* note 103, at 209- 210; MELNICK, *supra* note 102, at 80 (noting that "[t]he problem of greatest concern to environmentalists was the construction of coal-burning power plants in the Rocky Mountains . . . . With electricity often cheaper to transport than coal, utilities intended to build large mine-mouth plants adjacent to sources of low-sulfur coal and send electricity to metropolitan areas in southern California).

108. Domenici, *supra* note 105, at 481-82 (describing concerns about limits on economic growth as having the potential to "trigger a backlash that could jeopardize the entire Act"); VIETOR, *supra* note 103, at 164, 212 (quoting a Supreme Court brief for urban mayors and eastern industrial states: "The requirement of no-significant deterioration prevents rural regions from allowing lenient emission controls that are so much less expensive that an industry will

this case, the concern was precipitated by a 1972 court opinion holding that new industrial sources in "attainment areas" meeting the NAAQS could not cause a "significant deterioration" of local air quality, even if their emissions would not result in a NAAQS violation.[109] This holding imposed, in effect, more stringent ambient air pollution standards in rural areas relative to their urban counterparts.

EPA responded to the opinion by establishing the "Prevention of Significant Deterioration" (PSD) program, which was built around a three-level system of incremental standards for new facilities.[110] The program was strongly opposed by officials in rural western states, who viewed it as impeding economic development.[111] Congress responded by codifying the PSD program along with a second program directed largely at urban areas, New Source Review (NSR), which imposed heightened standards on new (or modified) sources in "nonattainment areas" out of compliance with one or more NAAQS.[112] The NSR program was itself designed to ameliorate the growth-inhibiting effects of a provision in the 1970 CAA that required all state plans to contain regulations for rejecting new or modified sources that would "'interfere' with the attainment or maintenance of a [NAAQS]."[113]

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have a financial incentive to relocate . . . no-significant deterioration removes the possibility of economic coercion between competing regions . . . ."); LESTER B. LAVE AND GILBERT S. OMENN, CLEARING THE AIR: REFORMING THE CLEAN AIR ACT 41 (1981) (describing congressional concerns that "environmental legislation was used to retard the migration of industry from the east").

109. Sierra Club v. Ruckelshaus, 344 F. Supp. 253, 256 (D.D.C. 1972); VIETOR, *supra* note 103, at 203.

110. MELNICK, *supra* note 102, at 88-89, 93-96.

111. VIETOR, *supra* note 103, at 203; A. STANLEY MEIBURG, PROTECT AND ENHANCE: JURIDICAL DEMOCRACY AND THE PREVENTION OF SIGNIFICANT DETERIORATION OF AIR QUALITY 162-63 (1991).

112. VIETOR, *supra* note 103, at 220-21 (characterizing the NSR program as having the same impact on nonattainment areas as PSD has on attainments areas, namely, "threaten[ing] to limit industrial growth and economic prosperity"); Karmer, *supra* note 104, at 126.

113. 41 Fed. Reg. 55524, 55525 (Dec. 21, 1976); VIETOR, *supra* note 103, at 220-21.

Coal interests were negatively impacted by both programs and thus received no countervailing benefits.[114] They nevertheless managed to extract one important concession to compensate for these losses. With the support of environmentalists, they obtained a major victory for eastern coal companies under the NSPS program through a provision that required all coal-fired power plants to reduce SO_2 emissions using a specific type of control technology.[115] This narrowly prescriptive form of technology-based regulation neutralized the favorable economics of using lower-sulfur western coal to meet the NAAQS for SO_2 and, in doing so, preserved the market for high-sulfur eastern coal; it was also essential to limiting the economic benefits of siting new coal-fired power plants in relatively pristine areas of the west.[116]

It is striking that none of the parallel programs in the CAA arose out of concerns about distinctive risks from major industrial sources—apart from electric utilities. In each case, the overriding concerns were that clean air regulations would impede economic development. The NSPS program was justified as offsetting the disparate impacts of the NAAQS; the NSR program was rationalized as limiting emissions on individual sources to allow for greater aggregate economic development in nonattainment areas; and the PSD program, which was motivated by concerns about emissions from electric utilities, was "designed to allow room for additional industrial growth . . . [in] the West [while avoiding] the mistakes of the industrialized East."[117] Despite the prevailing economic concerns, this pattern contrasts the evolution of regulations for diffuse, small sources, which continued to lag in comparison to those for major

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114. VIETOR, *supra* note 103, at 206-07 (describing industry claims that the PSD program would foreclose construction of 79 percent of the power plants then being planned); QUARLES, CLEANING UP AMERICA, *supra* note 10, at 193, 210.

115. LAVE & OMENN, *supra* note 108, at 41.

116. Pendley & Morgan, *supra* note 88, at 786, 792-93 (describing congressional concern that the NSPS would otherwise "give a competitive advantage to those States with cheaper low-sulfur coal and create a disadvantage for Mid-western and Eastern states where predominantly higher sulfur coals are available").

117. Domenici, *supra* note 105, at 480-81.

industrial sources, thereby inverting the dynamics predicted by public choice theory.

The 1990 Amendments to the CAA emerged out of the continuing problems with meeting the NAAQS and rising concerns about SO_2 emissions from coal-fired power plants. The amendments to the NAAQS program instituted an elaborate, multi-tiered system of compliance deadlines, which allowed for extensions through 2010.[118] The program for power plants was the first to adopt a market-based system for controlling emissions,[119] and similar to the PSD program it was designed to address specific impacts (such as interstate fallout from acid rain) of emissions from power plants.[120] Although the program was initially controversial, it ultimately proved to be both effective and efficient, and it is now widely viewed as being highly successful.[121]

Other significant amendments strengthened regulations for fuels used in motor vehicles and attempted to promote adoption of transportation control measures.[122] The regulations governing fuels have been particularly successful, in part because they have impacted emissions from all vehicles as opposed to only new ones. The transportation planning provisions, by contrast, were often ineffective, if not moribund, due to a combination of

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118. Clean Air Act Amendments of 1990, §§ 181(a), 186(a), 188(c); 42 U.S.C. §§ 7511(a), 7513(a) 7513(c) (the deadlines for attainment were from four to twenty years from 1990; the longest extension, to November 2010, was for areas rated as "extreme" for ozone levels); *see also* Thomas O. McGarity, *Missing Milestones: A Critical Look at the Clean Air Act's VOC Emissions Reduction Program in Nonattainment Areas*, 18 VA. ENVTL. L.J. 41, 51-55 (1999) (describing the modifications to the SIP process, which included a specific 1996 milestone for reducing ambient levels of criteria pollutants in non-attainment areas).

119. The power plant regulations were designed to address the interstate problem of acid rain, which was caused primarily by SO_2 emissions from coal-fired power plants and had emerged as a major political issue nationally. RICHARD E. COHEN, WASHINGTON AT WORK: BACK ROOMS AND CLEAN AIR 56-57, 127-28 (1992).

120. *Id.*; Clean Air Act Amendments of 1990, §§ 403, 407; 42 U.S.C. §§ 7651(b), 7651(f).

121. Bachman, *supra* note 9, at 292.

122. *Id.* at 56-57, 60-61, 137-38. It is interesting to note that environmentalists did not embrace alternative fuels at the time. *Id.* at 139.

political opposition and systemic barriers.[123] Overall, the 1990 Amendments continued the expansion of direct federal regulation with the new market-based regulations for electric utilities, but did little to alter the central framework of the CAA.

Several broad patterns emerge from the last century of air pollution policy. First, national clean air standards were neither preordained nor uncontroversial. The successes of municipal smoke-abatement programs through the 1950s provide valuable contrary evidence, as do the pioneering programs in California to combat smog, which anticipated or evolved alongside federal policies. Second, costly or burdensome regulation of the general public and small businesses has precipitated powerful backlashes against environmental policies. Such experiences propelled the compromise that preserved the pure health-based criteria of the NAAQS by delaying their enforcement (often for decades) in areas with the worst air quality.[124] Third, emissions of criteria pollutants from industrial sources have played a relatively minor, and often indirect, role in the evolution of clean air policy. The principal exception is controversies over coal-fired power plants, which shaped the PSD and NSPS programs; otherwise, state and local government concerns about economic development and maintaining a level regulatory playing field have dominated public debates.[125]

The historical record highlights both the long-standing prominence of small sources and the persistent challenges (political and otherwise) of regulating them. The evolution of clean air policy is also notable for its inconsistencies with public choice theory—large, concentrated industries have been often subjected to more stringent regulation than either the general

123. Mintz, *supra* note 21, at 191-92; Wahrman, *supra* note 21, at 189-92; MELNICK, *supra* note 102, at 300, 308-09.

124. The focus of this Article is on the primary, health-based NAAQS, as opposed to the secondary, welfare-based NAAQS, which in any event are set at the same levels for most of the criteria pollutants. *See* Craig N. Oren, *Is the Clean Air Act at A Crossroads?*, 40 ENVTL. L. 1231, 1242 (2011) (noting that "EPA has set secondary air quality standards for almost all pollutants as the same level as the primary, health-based standards").

125. MELNICK, *supra* note 102, at 82, 98-99 (highlighting the importance of large cities and states recognizing that the PSD program could "protect against massive industrial migration to clean air regions").

public or small businesses, despite their far greater numbers, more diffuse interests, and collectively larger impacts. Multiple reasons likely account for this divergence, including the visibility and salience of industrial emissions, but two are of particular importance here. First, once national ambient standards were put in place, technology-based regulations became an attractive means to level the regulatory playing field. For disadvantaged jurisdictions (i.e., highly populated urban areas), supplemental federal regulations *protected* local economic development, effectively inverting the favored industry argument against regulation.

Second, the interests of small businesses and the public may be diffuse, but in absolute terms they are not necessarily small—the pubic cares a great deal, for example, about having the freedom to use their cars and a variety of factors may make small businesses particularly resistant to regulation (e.g., limited expertise, capital, economies of scale). Under these circumstances, the motivation to speak out can transcend free-rider and collective-action problems.[126] Moreover, rather than being the impediment portrayed under public choice theory, large numbers can be a great asset, as widespread activism translates into political power.

These observations help explain why regulation of large industries has been relatively progressive, as well as why regulations that impact the public and small businesses have proved so challenging. More fundamentally, they reveal that the common assumptions that underlie theorizing on environmental federalism are much more tenuous than conventional wisdom would suggest. The next section builds on this historical overview by analyzing the principal sources of air emissions essential to understanding how the CAA operates in practice.

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126. KRIER & URSIN, *supra* note 5, at 269-71 (describing the positive feedback between population levels and willingness to take action).

II.
AIR POLLUTION IN THE UNITED STATES AS A NUMBERS GAME

I expect that many people, if asked, would identify industrial facilities as among the most important sources, if not the single largest source, of air pollution in the country. Debates over clean air policy reinforce this view, both with respect to their focus on regulating major industrial sources (particularly the New Source Review program) and their neglect of the implications of the close association between poor air quality and urbanization. The literature on the CAA also tends to focus either on high-level theories, such as debates over the use of cost-benefit analysis in setting NAAQS, the merits of uniform technology-based standards, and the virtues of market-based regulations,[127] or discrete categories of sources.[128] These divergent perspectives, either abstract or narrowly focused, tend to omit much of the context in which clean air policies are implemented. In many cases, the principal sources of air pollution, motor vehicles and small stationary sources, are overlooked altogether.

The empirical analysis that follows fills in this broader context by evaluating the sources and pollutants that have the greatest impacts on air quality. The EPA data reveal cross-cutting patterns in which air emissions are dominated by numerous small sources, which emit among a dozen or so pollutants that account for a disproportionate share of aggregate emissions and

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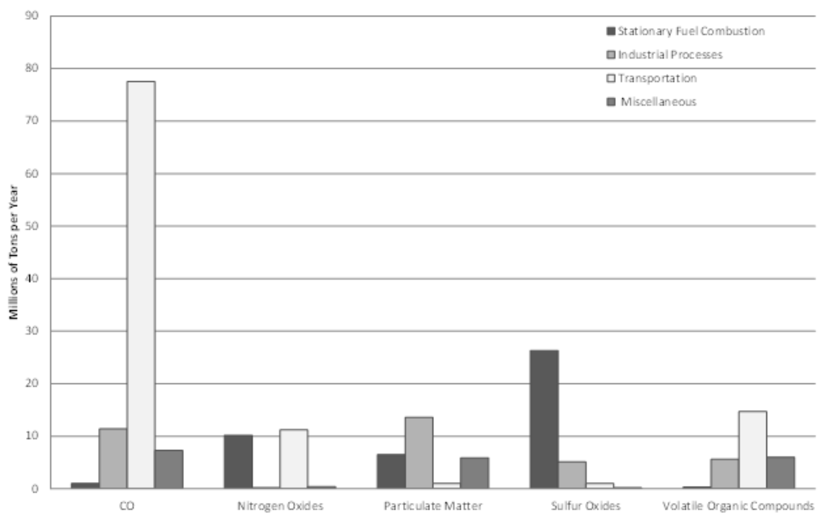
127. *See, e.g.*, Gary Coglianese & Gary Marchant, *Shifting Sands: The Limits of Science in Setting Risk Standards*, 152 U. PA. L. REV. 1255, 1340-46 (2004) (arguing that costs should be considered when setting NAAQS); Richard J. Pierce, *The Appropriate Role of Costs in Environmental Regulation*, 54 ADMIN. L. REV. 1237, 1272 (2002) (arguing that ways exist for EPA to work around the CAA's rule against considering costs when setting NAAQS); Howard Latin, *Ideal Versus Real Regulatory Efficiency: Implementation of Uniform Standards and "Fine-Tuning" Regulatory Reforms*, 37 STAN. L. REV. 1267, 1271 (1985) (arguing in favor of uniform standards under statutes such as the NAAQS under CAA on the grounds of efficiency in practice); William F. Pederson, *Why the Clean Air Act Works Badly*, 129 U. PA. L. REV. 1059, 1060-61 (1981) (arguing that the CAA's strict deadlines and elaborate procedures impede that refinement of policies as new scientific knowledge becomes available).

128. *See, e.g.*, BRUCE A. ACKERMAN & WILLIAM T. HASSLER, CLEAN COAL DIRTY AIR 10-12 (1981) (discussing the inefficiency of narrow technology-based standards under the CAA's New Source Performance Standards).

risks. Motor vehicles continue to be the single most important source of air pollution, and one major source, coal-fired power plants, stands out among industrial sources. The common denominator for most of the prominent sources is combustion of one form or another.

Figure 1: National Emissions of Criteria Pollutants in 1971



Linking back to the preceding section, the historical data on criteria pollutants highlight the continuities in the sources and types of emissions over time. Figure 1 displays the major classes of five criteria pollutants in 1971.[129] The data single out emissions from fuel combustion at stationary sources (i.e., electric utilities, heating), industrial processes, and motor vehicles. Industrial sources were the primary source of sulfur oxides (SO_x) and particulate matter (PM) emissions,[130] while

129. KRIER & URSIN, *supra* note 5, at 18. Figure 1 omits two criteria pollutants—lead and carbon monoxide (CO). In both cases, motor vehicles accounted for most of their emissions (about 80 percent in the case of CO). *Id.* CO was emitted in much larger quantities than the other criteria pollutants, and lead was not listed until the mid-1970s.

130. It is important to note that emissions of PM were not broken down by size at this time. This is significant because smaller particles, now known as "$PM_{2.5}$," pose much greater health risks than the larger ones, and we now know

motor vehicles were the largest source of the chemical precursors for smog, nitrogen oxides (NO_x) and volatile organic compounds (VOCs), as well as carbon monoxide (CO). However in urban areas, motor vehicles accounted for much higher proportions of criteria pollutants—in Los Angeles, 50 percent of PM emissions, 75 percent of NO_x emissions, 90 percent of VOC emissions, and essentially 100 percent of CO emissions.[131] These estimates are roughly consistent with the relative proportions of source-category emissions observed today.

EPA has also compiled data on emissions trends for criteria pollutants dating back to 1940, which is displayed in Figure 2 for three criteria pollutants.[132] The SO_2 data show the shift away from coal use for residential heating and transportation following the Second World War, as well as its revival in the late 1950s when large, centralized electric utilities were becoming the norm. The impacts of the clean air legislation in the 1960s and 1970s are also clearly visible, with peaks in emissions occurring from the mid-1970s to early 1980s. Moreover, the trends for all three criteria pollutants should be calibrated against the 65-percent rise in the U.S. gross domestic product during this period.[133] While the aggregate trends are moderately downward or flat, the emissions rates of individual sources declined dramatically over the period 1970 to 1998.

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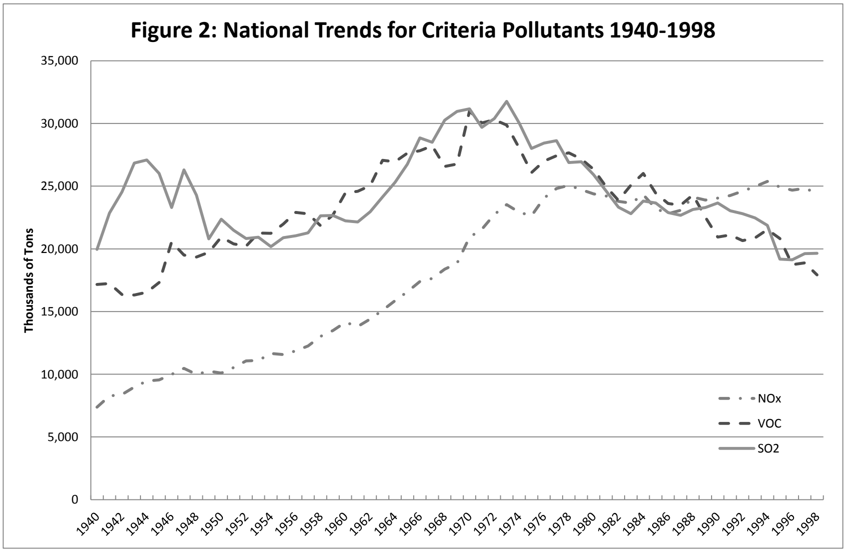
that industrial sources tend to emit PM with large average particle sizes.

131. KRIER & URSIN, *supra* note 5, at 19. Nationally, motor vehicles accounted for about four percent of PM emissions, fifty-one percent of NO_x emissions, and fifty-five percent of hydrocarbon emissions in 1971. *Id.* at 18.

132. Figures 2 and 3 display EPA National Emissions Inventory data. *See* U.S. ENVTL. PROT. AGENCY, NATIONAL EMISSIONS INVENTORY (NEI) AIR POLLUTANT EMISSIONS TRENDS DATA: 1900-1998 (2008), *available at* http://www.epa.gov/ttn/chief/trends.

133. U. S. ENVTL. PROT. AGENCY , OUR NATION'S AIR: STATUS AND TRENDS THROUGH 2010 5 (2011), *available at* http://www.epa.gov/airtrends/2011/report/fullreport.pdf (highlighting that gross domestic product increased sixty-five percent and vehicles miles traveled forty percent between 1990 and 2010).



The rapid rises in emissions displayed in Figure 2 is the backdrop to the increasing frequency and intensity of severe pollution events that were occurring in the mid to late 1960s.[134] The growth in emissions was particularly high in the mid-1960s when Congress first enacted clean air legislation to regulate emissions from motor vehicles. The data merely allude to the sense of alarm and rising levels of public activism towards end of the 1960s. At the time, intensifying air pollution was viewed as a major threat to society, with some pundits asserting that cities like New York would become "uninhabitable within a decade" if current growth rates persisted.[135] Even such a stalwart public official as the Secretary of Health, Education, and Welfare raised a warning in 1966 that "Americans might have to live in domed cities or go around in gas masks."[136]

One of the other notable patterns in these, and subsequent, data is the predominance of a few key pollutants. This phenomenon is reflected in the small number, six in all, of

134. KRIER & URSIN, *supra* note 5, at 104-06, 264-65

135. DEWEY, *supra* note 45, at 133 (quoting Norman Cousins, editor of the *Saturday Review*).

136. *Id.*

criteria pollutants.[137] The same pattern is also observed, however, for air toxics despite the large number of compounds (about 190 in total) designated as "hazardous air pollutants."[138] The twenty air toxics emitted at the highest levels in 2005 accounted for more than 90 percent of aggregate emissions nationally,[139] and among them just a handful accounted for a majority of the excess cancer risks.[140] Thus, although the levels at which air pollutants are emitted vary enormously across the country, the principal pollutants are remarkably consistent. The analysis that follows will focus on the key criteria pollutants (VOCs, NO_x, SO_2, and $PM_{2.5}$) and a small subset of air toxics, referred to here as the "NATA Toxics," which are responsible for most of the excess cancer risks nationally.[141]

The discussion in the sections below will examine the temporal trends and spatial patterns of air pollution in the United States. In addition to the data on criteria pollutants, the analysis will evaluate emissions data and cancer risk estimates for air toxics. Two primary motivations exist for analyzing them together: (1) they are often emitted by the same sources and thus are impacted by regulations under their respective programs;

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137. Bachmann, *supra* note 9, at 674, 690 (describing how EPA recognized early on that "the NAAQS should be considered as a last resort" and decided in 1971 to abandon plans to set NAAQS for 24 additional compounds).

138. *See* U.S. ENVTL. PROT. AGENCY, TOXICS RELEASE INVENTORY (TRI) BASIS OF OSHA CARCINOGENS (2011), *available at* http://www2.epa.gov/toxics-release-inventory-tri-program (showing that OSHA Carcinogens are Emergency Planning and Community Right-to-Know Act (EPCRA) Section 313 listed toxic chemicals that meet OSHA carcinogen standard).

139. Ammonia, hydrochloric acid, and hydrofluoric acid are also each emitted in very large quantities; all are associated with respiratory toxicity. Confined animal feeding operations emit the overwhelming majority of ammonia; coal-fired power plants emit most of the hydrochloric and hydrofluoric acid.

140. U.S. ENVTL. PROT. AGENCY, SUMMARY OF RESULTS FOR THE 2005 NATIONAL-SCALE ASSESSMENT 3–4 (2011), http://www.epa.gov/ttn/atw/nata2005/05pdf/sum_results.pdf [hereinafter NATA SUMMARY].

141. The NATA Toxics, which EPA has identified as national or regional risk drivers in the 2005 NATA, include the following chemicals: 1,3 Butadiene, 1,4 Dichlorobenzene, Acetaldehyde, Acrylonitrile, Benzene, Chromium Compounds, Formaldehyde, Naphthalene, Polycyclic Aromatic Hydrocarbons, and Tetrachloroethylene. *Id.* (identifying these chemicals as national and regional "cancer risk drivers").

and (2) the cancer risk data available for air toxics are valuable insofar as they provide a complementary and more fine-grained picture of air pollution nationally. Before proceeding with the discussion, the next section will describe the EPA data and their limitations.

A. *Understanding EPA Emissions Inventories and Excess Cancer Risk Estimates*

EPA has defined four categories of sources (point, nonpoint, onroad mobile, nonroad mobile), which I will use throughout the Article with one important qualification.[142] The terms "industrial source" and "point source" will be used interchangeably even though the point-source category includes smaller manufacturers and can encompass conventional nonpoint sources such as gas stations and dry cleaners.[143] Treating data on point sources as though they are limited to industrial sources will cause the estimates of emissions and risks from industrial sources to be conservative by virtue of being over inclusive. A benefit of this approach is that it operates as a rough offset for potential errors in the EPA data.[144]

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142. Point sources include large industrial facilities but also may include smaller commercial facilities, such as dry cleaners and gas stations. Nonpoint sources (previously "area sources") include all stationary sources not treated as "point sources" because their locations cannot be accurately measured at the facility level (e.g., small manufacturers, fireplaces/wood stoves, construction, gas stations, waste disposal). Mobile sources include onroad vehicles (for example, cars, trucks, and buses) and nonroad sources (for example, trains, ships, construction equipment, and farm machinery). Background emissions include natural sources, persistent air toxics (for example, those originating from a previous year's emissions), and long-range emissions (for example, those greater than fifty kilometers). ICF INT'L, AN OVERVIEW OF METHODS FOR EPA'S NATIONAL-SCALE AIR TOXICS ASSESSMENT 19 (2011) [hereinafter NATA OVERVIEW], *available at* http://www.epa.gov/ttn/atw/nata2005/05pdf/nata_tmd.pdf.

143. *Id.*

144. For example, the absence of reporting requirements for short-term releases associated with facility start-up, shut-down, and unanticipated disruptions, some of which can double the annual emissions of a facility, is a significant gap in the EPA data. NATA OVERVIEW, *supra* note 142, at 7; ENVIRONMENTAL INTEGRITY PROJECT, GAMING THE SYSTEM: HOW OFF-THE-BOOKS INDUSTRIAL UPSET EMISSIONS CHEAT THE PUBLIC OUT OF CLEAN AIR 1–3 (2004), *available at* http://www.environmentalintegrity.org/pdf/publications/eip_upsets_report_appendixa.pdf.

The analysis that follows will draw on three EPA databases (see Table 1); one that covers criteria pollutants and air toxics, and two that are specific to air toxics. EPA collects two types of data on air toxics—pollutant emissions levels and cumulative cancer risk estimates. The two types of data provide complementary views of air pollution across the country, as each metric has its limitations. Broad trends in emissions of air toxics, for example, reveal the relative importance of different source categories, whereas risk estimates provide a direct measure of harm but are subject to large uncertainties. The risk data for criteria pollutants are, somewhat surprisingly, much more limited; EPA releases only categorical data on whether a jurisdiction is or is not in attainment for a NAAQS—direct risk estimates are not available.

TABLE 1: EPA EMISSIONS AND EXCESS CANCER RISK DATABASES FOR AIR TOXICS

Database Name	*Metric*	*Sources Covered*	*Years Compiled*
Toxic Release Inventory (Air Toxics)	Emissions (Pounds)	Major point sources	Annually (1988-2010)
National Emissions Inventory (Air Toxics & Criteria Pollutants)	Emissions (Tons)	All source categories	Tri-Annually (2005, 2002, 1999, 1996)
National-Scale Air Toxics Assessment (Air Toxics)	Cancer Risk (excess mortality per million)	All source categories	Tri-Annually (2005, 2002, 1999, 1996)

The emissions inventory data will be drawn from the Toxic Release Inventory (TRI) and the tri-annual National Emissions Inventory (NEI). The TRI data are based on annually reported emissions of air toxics from major industrial sources,[145] whereas

145. *TRI Reporting Basics*, U.S. ENVTL. PROT. AGENCY, *available at* http://www2.epa.gov/toxics-release-inventory-tri-program/basics-tri-reporting (last visited April 21, 2014) (the TRI covers certain listed industries and any

the NEI data encompass emissions from all outdoor sources of air toxics and criteria pollutants (i.e., large and small stationary sources, onroad and nonroad mobile sources).[146] With the exception of VOCs, the data on criteria pollutants are quite reliable because they are relatively easy to measure and have been subject to extensive monitoring.[147] By contrast, only a subset of the data in the TRI and NEI are derived from direct measurements of VOC or air toxics emissions; most of the data are based on estimates derived from algorithms because direct measurement is difficult.[148]

EPA has a program dedicated to promulgating the "emissions factors" incorporated into the algorithms used to estimate emissions from individual sources (e.g., chemical storage tanks at refineries, kilns at cement plants).[149] Notwithstanding EPA's best efforts, the emissions factors are subject to significant uncertainties.[150] EPA's primary check has involved benchmarking its emissions inventories against direct measurements of air toxics.[151] These studies have found model estimates for several of the most important air toxics (i.e., acetaldehyde, benzene, butadiene, formaldehyde, naphthalene)

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company with greater than ten employees that manufactures or processes greater than 25,000 lbs. of TRI-listed chemicals annually or otherwise uses more than 10,000 lbs. of a listed chemical in a given year).

146. *2005 National Emissions Inventory Data & Documentation*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/ttn/chief/net/2005inventory.html (last visited April 21, 2014) (descriptions of data and detailed documentation on the 2005 NEI).

147. *Id.*

148. U.S. ENVTL. PROT. AGENCY OFFICE OF THE INSPECTOR GENERAL, EPA CAN IMPROVE EMISSIONS FACTORS DEVELOPMENT AND MANAGEMENT 4 (March 2006), http://www.epa.gov/oig/reports/2006/20060322-2006-P-00017.pdf (noting that emissions factors and simple algorithms are used for about eighty percent of emissions determinations).

149. David E. Adelman, *The Collective Origins of Toxic Air Pollution: Implications for Greenhouse Gas Trading and Toxic Hotspots*, 88 IND. L.J. 273, 294-97 (2013).

150. *Id.*

151. Nationally, air toxics are monitored at more than one thousand locations, although monitors are disproportionately located in urban areas. U.S. ENVTL. PROT. AGENCY, RESULTS OF THE 2005 NATA MODEL-TO-MONITOR COMPARISON 1-1, 2-4 (Dec. 2010), http://www.epa.gov/ttn/atw/nata2005/05pdf/nata2005_model2monitor.pdf.

to be within a factor of two of the ambient levels measured.[152] Thus although significant errors and uncertainties persist, they are approaching a level of reliability that experts would like to attain consistently.[153]

The second type of data cover excess cancer risk estimates that EPA generates tri-annually under its National-Scale Air Toxics Assessment (NATA).[154] The cancer risk estimates use the NEI emissions data as an input for the EPA exposure models (i.e., fate and transport of air toxics).[155] The NATA results are thus dependent on the accuracy of the NEI data, the EPA exposure models, and toxicity estimates for each compound. The complexity of the analyses that underlie the NATA cancer risk estimates introduces numerous opportunities for uncertainty and bias in the results.[156] Thus, while the NATA data provide a direct measure of risk, they must be interpreted cautiously.[157]

The uncertainties and potential biases in the NATA data vary along two dimensions—geographic scale and source category. For comparisons between jurisdictions, it is critical to keep in mind that the quality and detail of information differ between localities and that uncertainties in the data tend to be greater at smaller geographic scales.[158] EPA cautions against using NATA

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152. *Id.* at 4-1.

153. *Id.* at 3-20.

154. The cancer risks are expressed as "typical lifetime excess cancer risk" of, for example, ten per million. NATA OVERVIEW, *supra* note 142, at 70.

155. *Id.* at 71-77 (describing the sources of uncertainty in deriving cumulative risk estimates for air toxics). The NATA database contains estimates of neurotoxicity and respiratory harms, but to avoiding making the analysis too unwieldy, this Article focuses on the cancer risk data alone.

156. To give just one significant example, NATA "might not accurately capture sources that have episodic emissions (e.g., facilities with short-term deviations in emissions resulting from startups, shutdowns, malfunctions, and upsets). The models assume emissions rates are uniform throughout the year." *Id.* at 7.

157. EPA claims that NATA is a useful indicator of potential health risks from air toxics at "a given point in time," but different NATAs cannot be compared because the pollutants differ between them. U.S. GOV'T ACCOUNTABILITY OFFICE, CLEAN AIR ACT: EPA SHOULD IMPROVE THE MANAGEMENT OF ITS AIR TOXICS PROGRAM 29 (June 2006), http://www.gao.goc/assets/260/250607.pdf.

158. Adelman, *supra* note 149, at 294-97.

results "as a definitive means to pinpoint risk values within a census tract, to characterize or compare risks at local levels such as between neighborhoods, [or] to characterize or compare risks between states . . . ."[159] Similarly, because of the spatial averaging over a census tract (or county) "individual exposures or risks might differ by as much as a factor of 10 in either direction [i.e., above or below a calculated mean]."[160] For cross-source comparisons, the quality of data for specific source categories (e.g., point versus nonpoint sources) and for individual sources will vary.

EPA maintains that the estimates of relative contributions across source categories are among the most robust,[161] but the uncertainties will be substantial for even the best (typically more aggregated) data. The various sources of error are factored into a rough bounding analysis described in a prior article,[162] which shows that apart from a small number of jurisdictions the potential errors would not alter the conclusions of the analysis that follows.

B. Cars and Coal: The Emissions of the Many versus the Big

There are two striking patterns in the source-category data. First, motor vehicles and nonpoint source consistently account for a disproportionate share of the air pollutants emitted. A simple accounting of the criteria pollutants and NATA Toxics emitted by each source category clearly shows that such diffuse sources are responsible for most of the emissions. Figure 3 below displays the 2005 data for criteria pollutants.[163] Industrial sources were the primary source of SO_2, but one must keep in mind that a single type of facility, coal-fired power plants, was (and is) responsible for about 80 percent of SO_2 emissions nationally. For all of the other criteria pollutants, motor vehicles

159. NATA OVERVIEW, *supra* note 142, at 5.

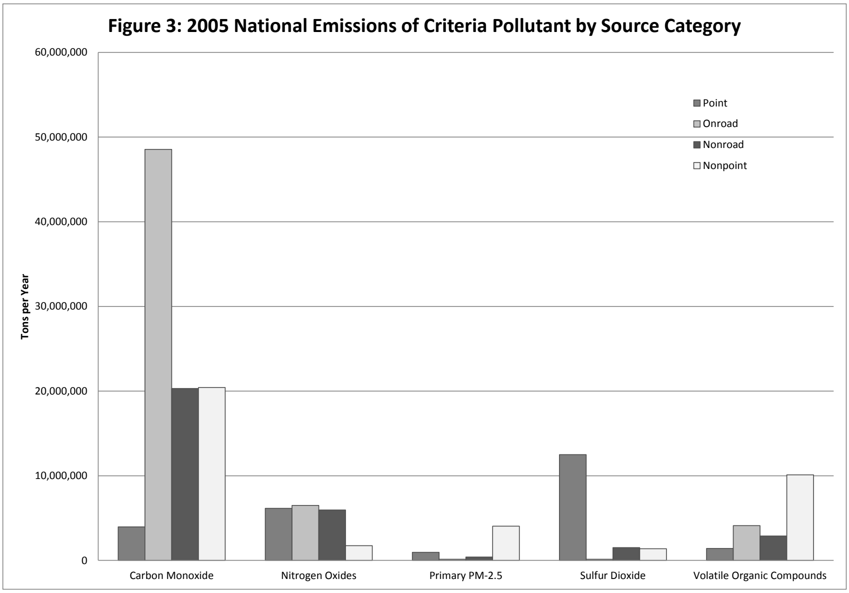
160. *Id.* at 69.

161. *Id.* at 5.

162. Adelman, *supra* note 149, at 333-34.

163. Carbon monoxide and lead are omitted in Figure 5. Nonpoint, onroad, and nonroad sources accounted for about ninety-five percent carbon monoxide emissions in 2005.

and nonpoint sources generated a majority of the emissions.



The national source-category emissions for air toxics roughly mirror those of the criteria pollutants. Industrial sources accounted for about 13 percent of the air toxics emitted nationally in 2005, whereas motor vehicles and nonpoint sources (e.g., gas stations, dry cleaners, surface-coating businesses, landfills) accounted for 48 and 39 percent, respectively.[164] These averages are fairly representative of variation in the underlying data—industrial facilities rarely accounted for more than a quarter of aggregate toxic emissions from outdoor sources at either the county- or census-tract level. Moreover, the distribution of emissions across source categories has been relatively stable since at least the mid-1990s.[165]

The observations for the NATA Toxics collectively are reinforced by the data on individual NATA Toxics (Figure 4 below). Setting aside chromium (not shown below), all of the leading air toxics are weakly associated with industrial

164. Adelman, *supra* note 149, at 293.
165. *Id.* at 292.

emissions.[166] The disaggregated data also highlight the degree to which emissions are skewed towards a small number of pollutants—benzene and formaldehyde are emitted in much larger quantities than the other NATA Toxics. Predictably, both are significant byproducts of combustion, although formaldehyde tends to have a broader range of nonpoint sources, whereas benzene is a component of gasoline and highly correlated with mobile sources.

The cancer risk data available for air toxics reinforce the findings from the emissions data. They are of particular value because they provide a direct measure of the average risks posed by each source category and they include census-tract level data. In relative and absolute terms, the cancer risks from industrial sources in most census tracts are quite modest, averaging about 3 per million nationally in 2005 (the cumulative national average for all source categories was fifty per million).[167] In spatial terms, about 98 percent of the U.S. population lived in census tracts where industrial sources were responsible for cancer risks below ten per million, whereas about 153,000 people (0.5 percent of the U.S. population) lived in census tracts where industrial sources (typically a steel mill or foundry) generated cancer risks in excess of one hundred per million.

The risks from industrial sources can also be evaluated using a combination of absolute and relative metrics. For example, one could single out census tracts in which industrial emissions of air toxics generated cancer risks of least twenty per million *and* accounted for more than 30 percent of the cumulative excess cancer risks. Using this conservative combination of metrics, just 240 census tracts out of 65,000 nationally would have qualified in 2005. To put this in a broader perspective, cancer risks from industrial sources exceeded five per million (10 percent of the national average) in just 6 percent of all census tracts (3792 in total).[168] These results highlight the degree to which small

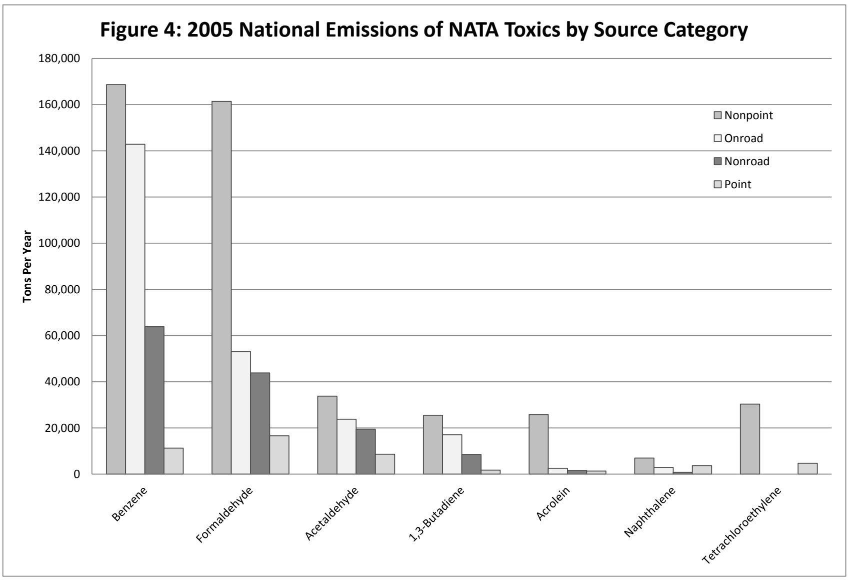
166. Arguably the most important one is chromium, as industrial sources (particularly steel mills and foundries) account for a little more than 80 percent of chromium emissions nationally. *Id.* at 321.

167. NATA SUMMARY, *supra* note 140, at 4.

168. In terms of absolute emissions, there are roughly 2,850 facilities

sources dominate emissions of air toxics nationally.

Second, motor vehicles and nonpoint sources account for an even higher share of the criteria pollutants and air toxics emitted in large metropolitan areas. Typically their share is above 80 percent, whereas industrial sources generally account for 6 to 15 percent of NO_x emissions, 15 to 30 percent of $PM_{2.5}$ emissions, and less than 10 percent of VOC emissions.[169] Further, the departures from these levels, which occur most often with NO_x and $PM_{2.5}$, are almost invariably associated with large coal-fired power plants. The consistency of the data and simple logic of the outliers lend additional credence to the overall picture presented by the EPA data.



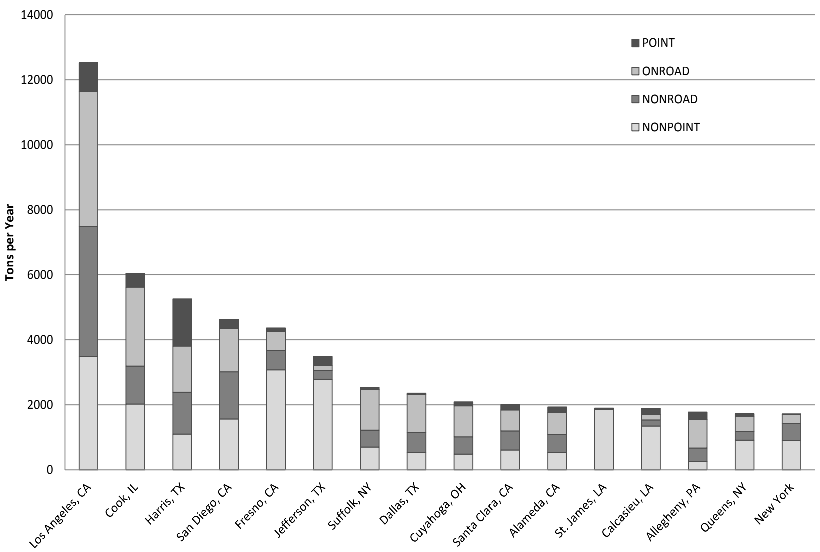
The patterns of urban emissions of NATA Toxics are a little more variable. Figure 5 displays the source-category emissions for the counties with the highest emissions levels. It shows a steep drop in emissions across the top four or five counties, all of

nationally that emit more than 1,000 pounds of carcinogens per year (about three pounds per day), and they are located in about 2,250 census tracts.

169. As the industrial capital of the United States, Houston provides a conservative benchmark, and yet its industrial sources emitted just 30 percent of the NO_x, 27 percent of the $PM_{2.5}$, and 22 percent of the VOCs.

which cover major metropolitan areas (e.g., Los Angeles, Chicago, Houston). Emissions from industrial sources are reflected in the top segment of each bar and, for all but Houston, account for less than 10 percent of the aggregate emissions. Houston, as shown later, is notable for having—by a huge margin—the largest concentration of industrial facilities in the country.[170] Thus, the fact that industrial sources in Houston accounted for only a quarter of the NATA Toxics emitted is further evidence that small sources have the greatest impact on air quality in urban areas.

Figure 5: County-Level Emissions of NATA Toxics in 2005



The county data for criteria pollutants and air toxics must be interpreted carefully, however, as counties vary greatly in size. For example New York County (Manhattan) encompasses a mere twenty-three square miles but has a population of 1.6 million, which equates to 71,000 people per square mile. Toward the other end of the spectrum, the county in which Houston is located (Harris county) encompasses 1,729 square miles and has

170. *See infra* pp. 289-291 for further discussion.

a population of 4.1 million, which equates to 2,367 people per square mile. Yet, the geographic variation notwithstanding, metropolitan areas with the highest emissions are generally the places most likely to be in nonattainment for one or more NAAQS and to have the highest excess cancer risks.

C. Urban Density and Air Quality

Ambient levels of criteria pollutants vary dramatically across the country, but the highest levels occur disproportionately in large urban areas.[171] Figure 6 displays the counties in nonattainment for ozone and small particulate matter ($PM_{2.5}$), which are the criteria pollutants that affect the largest number of people and are associated with the greatest cumulative health risks. The relatively small number of areas in nonattainment obscures the large size of the affected population—123 million people, or about 40 percent of the U.S. population, for ozone and 91 million, or about 30 percent of the U.S. population, for $PM_{2.5}$. The aggregate population in nonattainment areas for all six criteria pollutants is almost 150 million, which represented about half of the U.S. population in 2005.

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171. EPA provides data only on whether a county is in nonattainment for one or more NAAQS. While not a direct measure of risk, this classification indicates that criteria pollutants are at levels EPA deems harmful to public health.

FIGURE 6: NON-ATTAINMENT AREAS FOR THE CRITERIA POLLUTANTS OZONE AND PM2.5

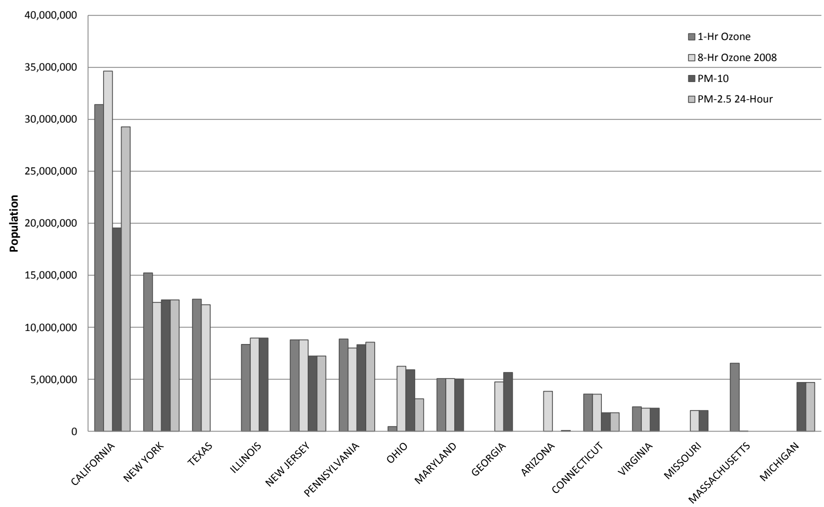
The strong correlation between high ambient levels of criteria pollutants and urbanization explains the divergence between population and geographic area—almost every nonattainment area, aside from California's Central Valley, encompasses a major metropolitan center. The cities in California, Texas, and the northeastern states, which are home to many of the largest cities in the country, stand out as areas of poor air quality for criteria pollutants. A quantitative measure of this geographic pattern is provided in Figure 7, which displays the populations of nonattainment areas by state. This grouping of the data also underscores the extent to which elevated levels of criteria pollutants are concentrated in a few states.

Ambient levels of air toxics, and the cancer risks associated with them, likewise vary across the country. Figure 8 displays the populations, at the census-tract level,[172] exposed to different

172. The census tract data mitigate the problem with county-level data of variable size, as census tracks in urban areas typically have an area of about

levels of cancer risks from NATA Toxics in 2005. While about 90 percent of the U.S. population was exposed to excess cancer risks of 20 to 80 per million, the distribution has a long tail that extends above 200 per million. In this tail of the distribution, 16 million people were exposed to excess cancer risks above 100 per million.

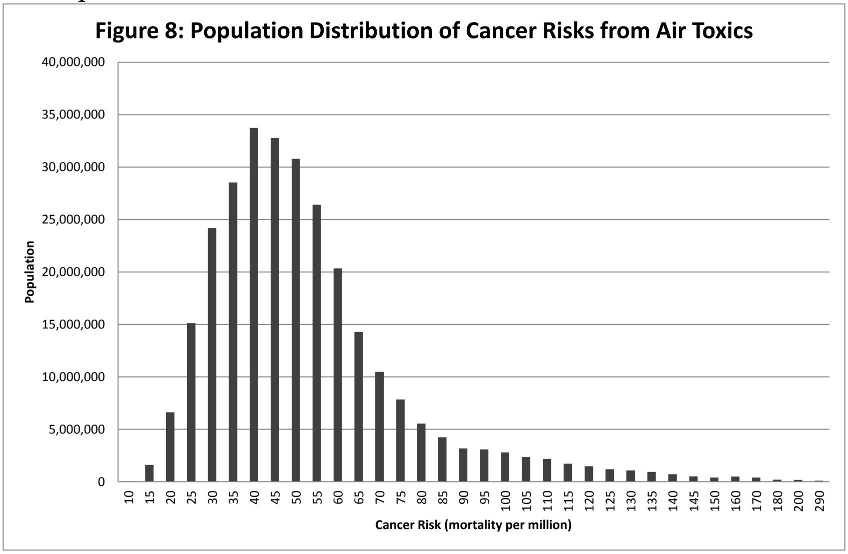
Figure 7: Populations of Ozone & PM Non-Attainment Areas



Most of the people who are exposed to these elevated cancer risks live in urban areas. In the ten largest cities, which were home to about 27 percent of the U.S. population in 2005, the average excess cancer risk from all outdoor sources of air toxics was 68 per million (by contrast, the cancer risks from industrial sources in these cities averaged about 2 per million). More importantly, the most severe risks from air pollution are concentrated in the largest cities: 88 percent of the 16 million people subjected to cancer risks above 100 per million—a level EPA deems clearly unacceptable—live in the ten largest

two square miles. NATA OVERVIEW, *supra* note 142, at 27–28. This general rule does not, however, hold for rural areas, where census tracts can have much larger areas.

metropolitan areas.[173]



At the other end of the distribution, only about 40 thousand people lived in census tracts where cumulative excess cancer risks from NATA Toxics were below 10 per million.[174] Moreover, these estimates represent a lower bound on cancer risks, as they are based on a subset of all air pollutants. This result reveals that cancer risks from air toxics exceed EPA's target risk of one per million by tenfold even in very remote areas of the country.[175] An important implication of this finding is that background risks from air toxics, whether from natural or distant anthropogenic sources, are responsible for a baseline

173. *See* 42 U.S.C. § 7412(f) (2012).

174. "NATA estimates that all 285 million people in the U.S. have an increased cancer risk of greater than 10 in one million." NATA SUMMARY, *supra* note 140, at 4. I calculated that about 39,000 people live in census tracts with cancer risks between 7 and 10 per million.

175. *See* 42 U.S.C. § 7412(f) (2012). *See also* NAT'L ASS'N OF CLEAN AIR AGENCIES, CLEANER CARS, CLEANER FUEL, CLEANER AIR: THE NEED FOR AND BENEFITS OF TIER 3 VEHICLE AND FUEL REGULATIONS 2 (Oct. 2011) (observing that "every person in the U.S. has an increased cancer risk of over 10 in one million . . . and the majority of compounds that cause this risk comes from motor vehicles").

excess cancer risk of roughly 10 per million that cannot be influenced by local regulatory efforts.

FIGURE 9: EXCESS CANCER RISKS FROM NATA TOXICS BY COUNTY IN 2005

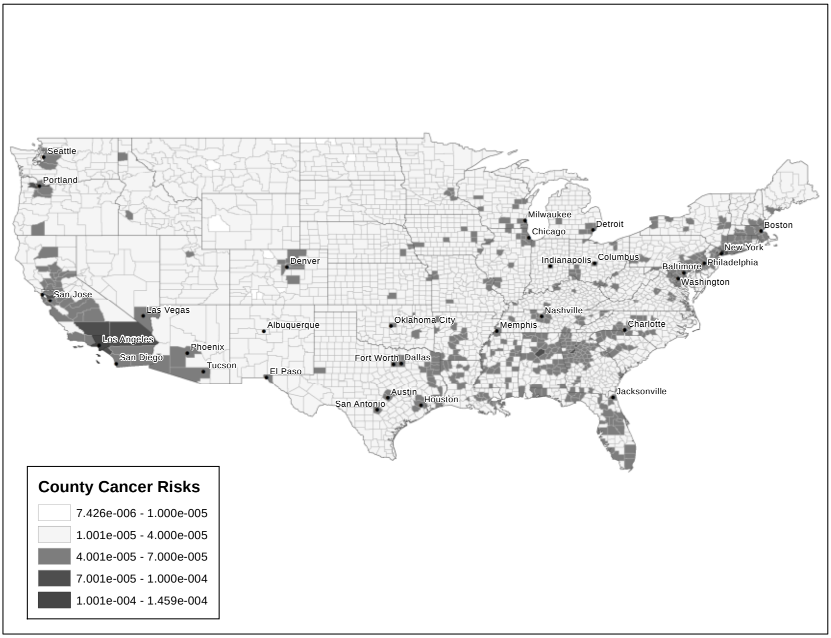


Figure 9 displays census-tract-level data on the excess cancer risks from air toxics.[176] While elevated cancer risks are closely associated with urban areas, the impacts from industrial sources and inter-jurisdictional transport of air toxics is evident in the rural areas of the southeastern states. However, unlike the largest metropolitan areas, the cancer risks in virtually all of these areas still fall within the range of 40 to 70 per million, making them comparable to the national average of 50 per million. These results further illustrate the significance of the background sources and risks noted above.

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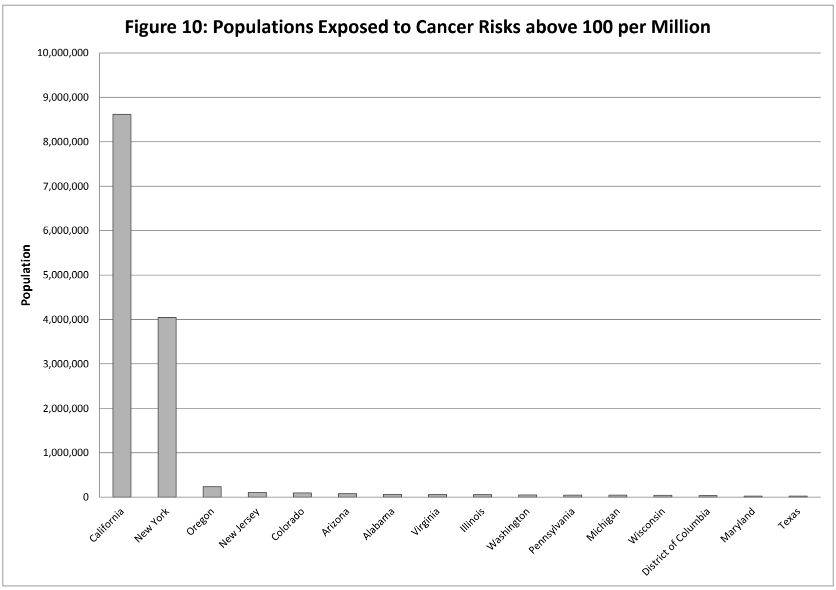
176. The data in Figure 9 are displayed at the county level, but the excess cancer risks displayed are based on the census tract in each county with the highest cumulative cancer risk. This representation of the data mitigates the averaging effects of county-level data and visually highlights the areas with the highest cancer risks.

Similar to the observations for criteria pollutants, California and New York stand out as hotspots for toxic air pollutants. Figure 10 displays the aggregate state populations of census tracts with excess cancer risks above 100 per million for NATA Toxics.[177] While the number of people affected is collectively much smaller than the population living in nonattainment areas nationally,[178] the geographic concentration is far more skewed towards large urban areas. The results expose the extreme geographic concentration of the populations most impacted by air toxics and the strong link to intense urbanization.



An obvious implication of this analysis is that while a great majority of the land area in the country has relatively good air

177. The states displayed in Figure 10 encompass 99 percent of the population exposed nationally to greater than a 100 per million excess cancer risk from air toxics.

178. If the analysis of nonattainment areas is limited to counties with highest ozone levels, areas categorized as "extreme" or "severe," the geographic distribution is similarly skewed. All of the extreme areas are in southern California, and the severe areas are all associated with major metropolitan areas (e.g., Atlanta, Baltimore, Chicago, Houston, New York, Philadelphia, Washington, D.C.).

quality, a large fraction of the population does not benefit from it because about 84 percent of the U.S. population lives in urban areas. This finding is also consistent with the observation that about 50 percent of Americans live in areas not meeting one or more NAAQS and that 88 percent of the population subjected to the highest excess cancer risks from air toxics live in one of the ten largest U.S. cities.[179]

D. Outliers and Hotspots of Industrial Emissions

Any discussion of industrial sources must be conditioned on the recognition that they typically generate a small fraction of the air pollutants emitted. As noted above, industrial sources account for about 13 percent of the air toxics emitted,[180] and for facilities other than coal-fired power plants, a lower percentage of criteria pollutants. Nevertheless, in certain jurisdictions they can dominate emissions of specific pollutants—chromium emissions from steel mills, for example, are significant in areas of the Midwest and south.[181] Outside these relatively rare instances,[182] however, emissions from industrial facilities are obscured by those from other source categories and therefore must be examined separately.

The dominance of emissions from electric utilities is the most salient observation from Figure 11, which displays the percentages of emissions of criteria pollutants by industrial source category. With the exception of VOC emissions,[183] the skewed nature of industrial emissions extends beyond electric utilities. The top five industries emitted more than 90 percent of the emissions for each of the other criteria pollutants, and electric utilities and industrial boilers together accounted for 90

179. *See* PAUL MACKUN & STEVEN WILSON, U.S. CENSUS BUREAU, U.S. POPULATION DISTRIBUTION AND CHANGE: 2000 TO 2010 4 (Mar. 2011), http://www.census.gov/prod/cen2010/briefs/c2010br-01.pdf (stating that almost 84 percent of the U.S. population lives in urban metropolitan areas).

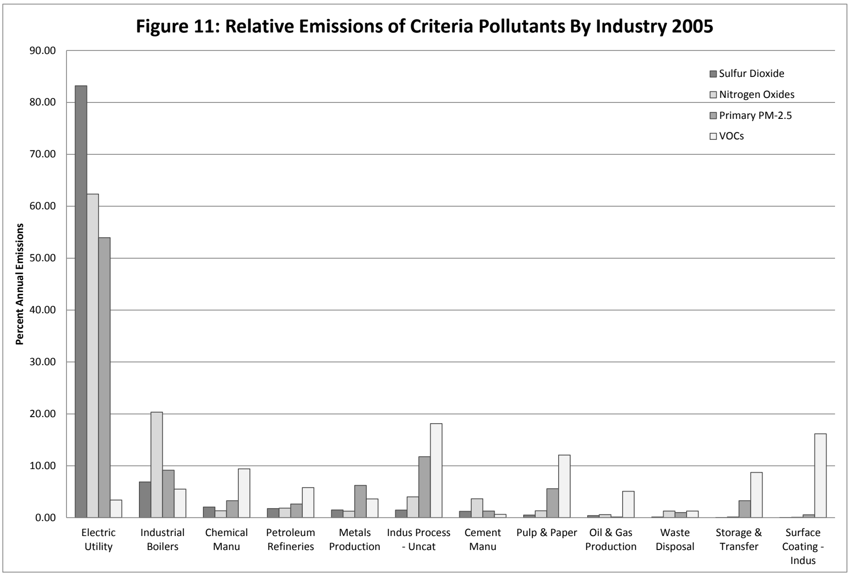
180. Adelman, *supra* note 149, at 317.

181. *Id.* at 320-21.

182. *Id.*

183. No single industry accounted for more than 20 percent of total VOC emissions and most of them much less.

percent of the SO_2, 82 percent of the NO_x, and 63 percent of the $PM_{2.5}$ emitted nationally. Industrial emissions of air toxics are also skewed towards a subset of industries, with the top five industries accounting for more than 85 percent of the NATA Toxics emitted nationally in 2010.



The geographic distribution of industrial emissions of criteria pollutants is divided between the flatter pattern observed for VOCs versus the skewed patterns found for SO_2, $PM_{2.5}$, and NO_X (see Figure 12).[184] Emissions of the latter three pollutants essentially tracked the locations of their most prominent sources—coal-fired power plants. The top four states, for example, each have significant numbers of coal-fired power plants and among the largest plants in the country.[185] Thus, although industrial emissions of most criteria pollutants are

184. The relatively low levels of emissions for $PM_{2.5}$ and VOCs obscure the variation in the data across these criteria pollutants, but a separate review of the data for $PM_{2.5}$ reveals that it is roughly consistent with the patterns for SO_2 and NO_x.

185. Brian H. Potts, *The Court Kills EPA's Cross-State Air Pollution Rule – But Which States Really Won?*, 25 ELECTRICITY J. 36, 41-43 (2012) (analyzing the states with the largest emissions from power plants).

dominated by electric utilities, outside the Midwest the sources are geographically spread out.

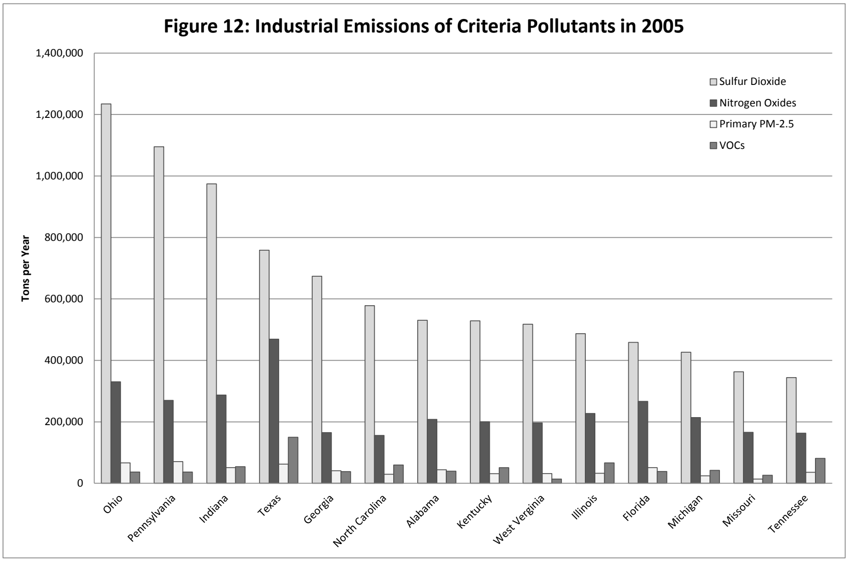


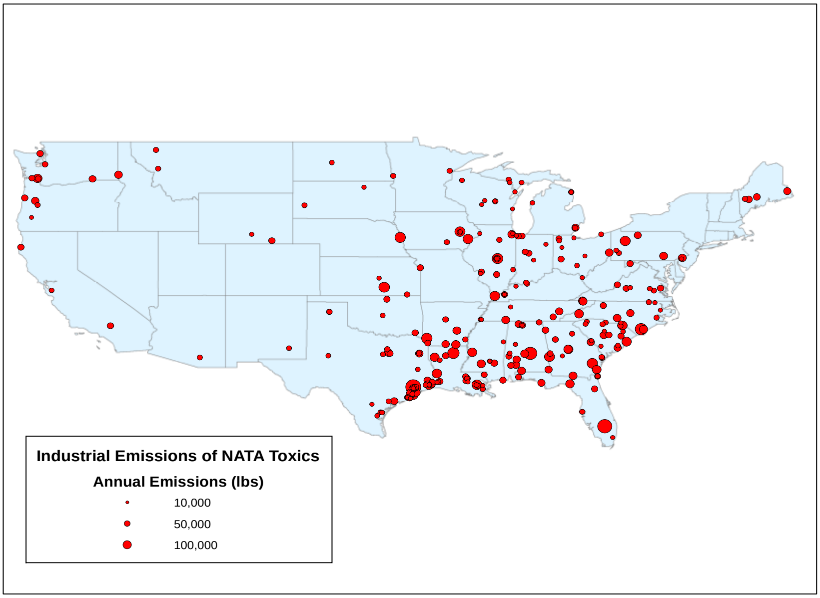
Figure 13 depicts the largest industrial sources of NATA Toxics. It highlights the degree to which NATA Toxics are concentrated in the Midwestern and Southern states, as well as the small number of large industrial sources in the western and northeastern parts of the country. This map is almost a negative image of Figures 6 and 9, which display the nonattainment areas for ozone and $PM_{2.5}$ and the overall excess cancer risks (i.e., all source categories) from NATA Toxics, respectively. Figure 13 demonstrates that industrial emissions of air toxics are weakly correlated with high levels of air toxics in large urban areas.

The regional disparities evident in the national data for industrial sources are amplified by the aggregate state-level figures (*see* Figure 14). Industrial sources of air toxics are clustered in a few states and counties,[186] but Texas stands out

186. Approximately 75 percent of NATA Toxics emitted by industrial sources are concentrated in 15 states, and more than 90 percent of industrial emissions occur in just 300 counties (ten percent of the number nationally).

above all of the rest with more than double the emissions of second place Louisiana. Moreover, the distribution of industrial emissions has remained consistent over roughly the past two decades—Texas has accounted for about 15 percent of the NATA Toxics emitted nationally since 1988. The Houston area (Harris County), however, is an outlier even for Texas—county-wide emissions of NATA Toxics exceeded those in all but two states and equaled those of second-place Louisiana (see Figure 14).[187]

FIGURE 13: INDUSTRIAL SOURCES SCALED TO THEIR EMISSIONS OF NATA TOXICS[188]



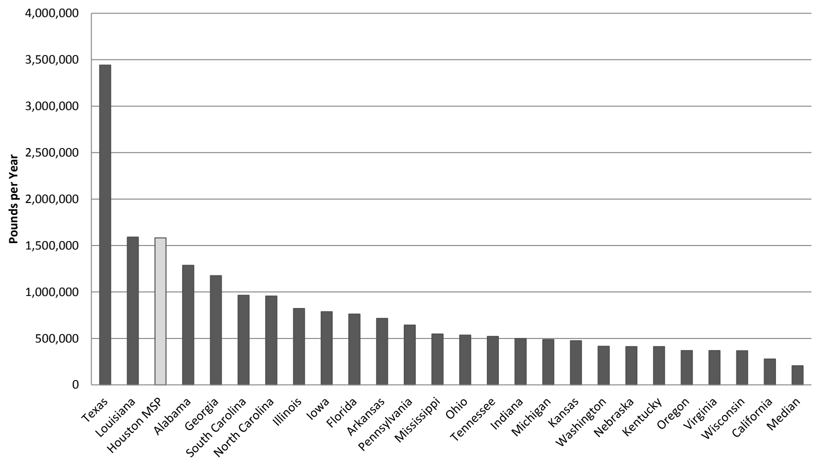
The geographic clustering of major industrial sources extends to the local level in other areas as well. In both Texas and Louisiana, industrial emissions of air toxics in three cities

187. In 2010 Texas had 352 major facilities emitting NATA Toxics, whereas Ohio had 242, Pennsylvania had 210, California 189, Illinois 178, New York 165, and Indiana 165. Moreover, while all of these states lost facilities after 2002, Texas lost them at a lower rate and has experienced growth since 2010.

188. The map displays industrial sources with annual emissions of NATA Toxics greater than 25,000 pounds; about 260 facilities nationally meet this criterion.

collectively accounted for about 60 percent of the statewide total,[189] and similar patterns, though less extreme, are observed in other states with high emissions from industrial sources.[190] Texas and Louisiana therefore had both the highest aggregate emissions from industrial sources in 2010 and the highest geographic clustering of the facilities responsible for them.

Figure 14: Industrial Source Emissions of NATA Toxics by State



The data on industrial sources are remarkable for their consistency. With the exception of VOCs, industrial emissions of criteria pollutants are dominated by coal-fired power plants, which are loosely centered in several Midwestern states. Similarly, industrial sources of air toxics are concentrated in a small number of states that, with a few exceptions (Chicago, Los Angeles, Pittsburgh) are located in the southeast. Texas and Louisiana stand out among these states; yet, mobile and

189. It is important to remember that quantity does not track strictly with risk; emissions of highly toxic emissions (such as chromium) in relatively small amounts can pose significant risks. Madeleine Strum et al., *Projection of Hazardous Air Pollutant Emissions to Future Years*, 366 SCI. TOTAL ENV'T 590, 597–98 (2006).

190. Other states with high emissions include Indiana, Illinois, and Alabama, and in each case the state's top three municipalities accounted for about forty-five percent of the state total.

nonpoint sources still account for a majority of the air toxics emitted in each state. The Houston area is exemplary in this respect—nonpoint and mobile sources dominate cumulative emissions of air toxics in the industrial capital of the country. This singular result highlights the degree to which air pollution is a problem for which we are all responsible.

The EPA data collectively provide a global picture of the many sources of air pollution and their geographic distribution. The small relative contributions of industrial facilities—other than coal-fired power plants—and the dominance of nonpoint and mobile sources are evident in virtually all of the data for criteria pollutants and air toxics. These patterns recur whether one evaluates source contributions in terms of emissions levels or risks, and they persist at geographic scales ranging from census tracts to the nation as a whole.

The prevalence of emissions from small sources exposes the disconnect between reality and the prevailing focus on large industries in scholarship on environmental federalism. Moreover, while the importance of emissions from motor vehicles is widely recognized, direct federal regulation of emissions from motor vehicles has been uncontroversial (owing to their interstate movement and national market), and thus has not figured prominently in the scholarly debate. At the same time, the lack of data on emissions from nonpoint sources, which have not emerged until relatively recently, has greatly reduced their visibility and consideration by academics. The EPA data demonstrate the importance of this oversight—environmental federalism is built on an inverted view of source emissions that has distorted understanding about the prominence of public choice dynamics. This divergence is made more acute by the qualitative differences between large and small sources and the strong association of poor air quality with urbanization.

III.
THE LIMITS OF COOPERATIVE FEDERALISM UNDER THE CLEAN AIR ACT

The NAAQS program and its system of cooperative federalism are considered to be the cornerstone of the CAA and integral to its many successes.[191] However, the literatures on the CAA and cooperative federalism have done little to connect their accounts of the law to the realities of its implementation. This section will examine the implications of the divide between conventional views about the CAA and the operation of the statute in practice. It will show that the public choice justifications (i.e., regulatory races to the bottom, agency capture) favored by academics for justifying federal intervention are either inapplicable or substantially weaker than often presumed. Further, while other grounds exist for federal regulation, notably interstate transport of air pollutants, this section will argue that the dominance of small sources elevates the importance of local regulation and alters the justifications for federal interventions.

Scholarship on environmental federalism is divided into two primary schools. The first is based on the "matching principle" derived from classical economics, which holds that regulation should occur at the lowest level of government for which its costs and benefits are fully internalized.[192] The second school, "dynamic federalism," rejects the view that an optimal level of government exists for setting regulations and argues instead for strong, overlapping state and federal jurisdiction.[193] Despite their differences, both schools rely heavily on the insights of

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191. *See*, *e.g.*, Grodsky, *supra* note 8, at 201.

192. *See, e.g.*, Stewart, *supra* note 1, at 1210, 2015-16 (explaining the theoretical underpinnings of the classical school); Henry N. Butler & Jonathan R. Macey, *Externalities and the Matching Principle: The Case for Reallocating Environmental Regulatory Authority*, 14 YALE. L. & POL'Y REV. 23, 25 (1996) (describing this rule as the "matching principle"); Esty, *supra* note 1, at 587. Some scholars also acknowledge that federal regulation may be appropriate for certain intrastate environmental problems, such as when state standards are sub-optimally lax due to the influence of powerful business interests or when competition between states for mobile industries precipitates a "race-to-the-bottom" in standard setting among states. Stewart, *supra* note 1, at 1210, 2015-16.

193. Dynamic federalism is premised on the benefits of overlapping jurisdiction—innovation, plurality, dialogue, and redundancy—offsetting the loss of uniformity, finality and accountability. *See, e.g.*, Robert A. Schapiro, *Toward a Theory of Interactive Federalism*, 91 IOWA L. REV. 243, 296 (2005); Robert A. Schapiro, *Justice Stevens' Theory of Interactive Federalism,* 74 FORDHAM L. REV. 2133 (2006); William W. Buzbee, *Contextual Environmental Federalism,* 14 N.Y.U. ENVTL. L. J. 108, 114, 122-26 (2005).

public choice theory[194] while accepting the virtues of state-level regulation in light of the greater local knowledge and political accountability of state versus federal officials.[195] The discussion that follows will show that the reliance of the prevailing theories on public choice theory should be reevaluated given the importance of small sources.

The leading theories of environmental federalism also miss critical shortcomings of the CAA's system of cooperative federalism.[196] Among proponents of the classical school, the shared framework is never efficient because it violates the matching principle by compromising state or federal authority depending on whether the issue is local or national in scope.[197] For advocates of the dynamic school, cooperative federalism falls short because federal regulations are often so detailed that they effectively preclude states from experimenting with alternative

194. *See, e.g.*, Revesz, *Race-to-the-Bottom*, *supra* note 1, at 1210-12; Richard O. Zerbe, *Optimal Environmental Jurisdictions*, 4 ECOLOGY L.Q. 193, 245 (1974); Kirsten H. Engel, *Harnessing the Benefits of Dynamic Federalism in Environmental law*, 50 EMORY L.J. 178-79 (2006) (observing that "[i]f interest groups succeed in negatively influencing a policy initiative at the federal level, under a dynamic system of federalism, the states still have a shot at correcting the ultimate policy result"); Buzbee, *supra* note 193, at 125.

195. Revesz, *Race-to-the-Bottom*, *supra* note 1, at 1222 (arguing from the classical school that "[g]iven our system of federalism, in which state and local governments have broad police powers, . . . there ought to be an affirmative justification for federal intervention"); Kirsten H. Engel and Scott R. Saleska, *Subglobal Regulation of the Global Commons: The Case of Climate Change*, 32 ECOLOGY L.Q. 183, 209 (2005) (highlighting the value of state regulatory authority even for a global environmental problem such as climate change).

196. Recall that under cooperative federalism, state programs must adopt environmental standards at least as stringent as the federal standards, and the federal government retains oversight authority to ensure that states effectively implement them. EME Homer City Generation v. Envtl. Prot. Agency, 696 F.3d 7, 12, 29-30 (D.C. Cir. 2012).

197. Joseph F. Zimmerman, *Nation-State Relations: Cooperative Federalism in the Twentieth Century*, 31 PUBLIUS 15, 24-25 (Spring 2001) (arguing cooperative federalism increases complexity and undermines accountability); Michael S. Greve, *Against Cooperative Federalism*, 70 MISS. L.J. 557, 608 (2000) (criticizing cooperative federalism and suggesting that regulatory programs should be controlled either by the federal or state governments); Stewart, *supra* note 1, at 1215 (arguing that cooperative federalism's reliance on state implementation can impede federal action on environmental problems of truly national scope).

approaches.[198] Viewed through either the classical or dynamic theories, cooperative federalism sacrifices either too much efficiency or too much diversity and innovation. This section will show that neither school is attentive to the overlapping programs and systemic barriers that have undermined clean air policy and constrained cooperative federalism under the CAA.

The persistent neglect of small sources is in part a product of the dearth of empirical work on state and federal programs. Most studies have focused either on the variation in enforcement levels across states or the transfer of individual state-level innovations vertically to the federal level or horizontally between states.[199] Further, there has been little analysis in the legal literature on the relative efficacy of federal and state programs. Yet, this information has direct relevance to questions of efficacy and whether a diversity of approaches and regulatory innovations have meaningful impacts. The next section examines different lines of empirical evidence relevant to assessing the implementation of the CAA, while the implications for environmental federalism and the CAA are discussed in the section that follows it.

A. The Dependence of State Clean Air Programs on Federal Regulations

The distribution of air emissions across source categories (e.g., mobile, small stationary, industrial) bounds state action under the CAA's framework for cooperative federalism. Experience shows that where states have broad authority to regulate, they

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198. *See, e.g.*, Robert Glicksman, *From Cooperative to Inoperative Federalism: The Perverse Mutation of Environmental Law And Policy*, 41 WAKE FOREST L. REV. 719, 800-803 (2006) (arguing that cooperative federalism binds the hands of both the federal government and the states). Nevertheless, some scholars sympathetic to the dynamic framework cite cooperative federalism approvingly, although with some qualifications. *See* Buzbee, *supra* note 193, at 114, 122; Schapiro, *Toward a Theory of Interactive Federalism*, *supra* note 193, at 284-85.

199. Evan J. Ringquist & David H. Clark, *Issue Definition and the Politics of States Environmental Justice Policy Adoption*, 25 INT'L. J. PUB. ADMIN. 351, 364 (2002); B. Dan Wood, *Federalism and Policy Responsiveness: The Clean Air Case*, 53 J. POL. 851, 851 (1991); Matthew Potoski, *Clean Air Federalism: Do States Race to the Bottom?*, 61 PUB. ADMIN. REV. 335, 338-39 (2001).

tend to be most limited by public opposition and administrative barriers. This observation is found to be consistent with independent empirical studies on the effectiveness of state implementation plans under the NAAQS program and national trends in emissions reductions. Taken together, these studies and the empirical findings described above provide strong evidence that federal programs are driving most of the reductions in criteria pollutants.

Motor vehicles. Emissions from motor vehicles account for a majority of CO and NO_x emissions, and more than a third of VOC emissions. Yet with the exception of California (and derivatively states that choose to adopt California's standards), only the federal government can set emissions standards for motor vehicles.[200] Most states are thus limited to regulating emissions *indirectly* through transportation planning and incentive programs,[201] which have been subject to significant public opposition since the backlash against transportation policies in the 1970s. Consequently, experience with transportation policies has been marked largely by failure,[202]

200. The authority California has to set emissions standards for motor vehicles has been of great practical importance to air quality in the state, as well as the fourteen other states that have adopted the California standards. This exception merely demonstrates that state programs can be successful when they have the authority to regulate sources with significant emissions and for which viable regulatory options exist. In the case of California, its success may also be attributable to the widespread nature of severe air pollution in the state and the geographically broad public support for state action. In most other states, nonattainment areas are centered around metropolitan areas, suggesting that the political support for regulating air pollution is likely to be less consistent.

201. Wahrman, *supra* note 21, at 193 (stating that "[i]n contrast to stationary sources, state power to limit emissions from mobile sources is restricted, even though mobile sources contribute significantly to ambient air quality violations").

202. Wahrman, *supra* note 21, at 191-92 (finding that the more aggressive transportation measures in the 1990 Amendments to the CAA have "not resulted in significant motor vehicle emission reductions"); Mintz, *supra* note 21, at 167, 191 (stating that TCMs "have proved much more difficult to implement than emissions controls"). Even inspection and maintenance programs, which are cost-effective, have been contentious and often undermined by public opposition. Thomas O. McGarity, *Regulating Commuters to Clear the Air: Some Difficulties in Implementing a National Program at the Local Level*, 27 PAC. L.J. 1521, 1652 (1996) (concluding that "[p]erhaps the clearest lesson of

with few successful programs and states still struggling to identify cost-effective transportation control measures (TCMs).[203]

In a recent survey, state regulators indicated that the role of TCMs is "'small, minor, or very small'—in the range of 1-3% of needed reductions for attainment."[204] They also "complain[ed] that their [regulatory] toolbox is filled with high-cost or politically unacceptable approaches, whereas "technology-based measures [are the] most cost-effective and promising."[205] The central dilemma for state policymakers is that the TCMs with the greatest promise—gasoline taxes, mileage-based registration fees, congestion pricing—continue to be nonstarters politically.[206] A telling indicator of this impasse is that, rather than adopting measures to reduce vehicle-miles traveled or constructing new mass transit systems, the State Implementation Plans (SIPs) for meeting the NAAQS in California and New York have emphasized deployment of low- and zero-emissions vehicles.[207]

Nonpoint sources. Emissions from nonpoint sources account for a majority of VOC and $PM_{2.5}$ emissions, as well as a quarter of CO emissions.[208] States possess broad authority to regulate

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the history of state implementation of I/M programs is that there are generally no adverse consequences for states that thumb their noses at EPA and refuse to take the appropriate implementation steps"); HARRINGTON ET AL., *supra* note 21, at 18.

203. HARRINGTON ET AL., *supra* note 21, at 16-17 (reporting on a survey of state officials who said that they were "scraping the barrel" to identify TCMs that would enable them to meet the ozone NAAQS and that they had difficulties "identifying cost-effective TCMs"). After noting that these problems were not limited to their case study, the authors cite a respondent who "indicated that other than more aggressive measures (e.g., no-drive days), no significant reductions can result from TCM implementation. *Id.*

204. *Id.* at 18.

205. *Id.* at 16-17.

206. *Id.* at 18, 33 (noting that such programs are "very unpopular, and one of the greatest unsolved problems of transportation policy analysis is devising a politically acceptable incentives-based program to deal with the social costs of vehicle use"). *See generally* Mintz, *supra* note 21, at 206 (discussing the failure of the federal government's program to promote congestion pricing nationally).

207. Mintz, *supra* note 21, at 185, 188

208. The diffuse nature of nonpoint sources is illustrated by those with the largest emissions nationally in 2005: (1) CO – residential fireplaces and woodstoves, wildfires, agricultural field burning, and opening burning of waste (fifty percent of emissions were from "miscellaneous sources"); (2) $PM_{2.5}$ –

nonpoint sources, but difficult politics and administrative barriers have impeded state regulation, although accurate assessment is difficult given the dearth of information.[209] Regulators have openly acknowledged the difficulties of regulating nonpoint sources, particularly the administrative challenges involved in developing standards for a "diversity of sources" and the need to have multiple control strategies.[210] A 2004 report on "Air Quality Management" issued by the National Research Council provides a clear-eyed and cautionary statement on current efforts to regulate nonpoint sources:

> To date, the efforts to control [nonpoint] sources have been relatively scattered and have slipped far behind mandated implementation schedules . . . . However, in the absence of a

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unpaved roads, crop tilling and livestock dust, residential fireplaces, agricultural field burning, and open burning of waste; NO_x – fuel combustion (commercial/institutional facilities, small-scale industrial boilers, residential properties), waste disposal, and in certain states (i.e., TX, CA) oil and gas production; and (3) VOCs – solvent emissions, industrial surface coating, gas stations, architectural surface coating/paint emissions, wildfires, and residential fireplaces. In large urban areas, the mix of nonpoint sources varies substantially, but nonpoint sources that are often prominent include the following: (1) $PM_{2.5}$ – restaurants, construction, unpaved roads, industrial boilers, waste disposal, and residential fireplaces; and (2) VOCs – consumer products, surface coating companies, architectural surface coating/paint emissions, gas stations, degreasing, and waste disposal. Other than residential fuel combustion, aggregate emissions of NO_x are low from nonpoint sources.

209. Similar problems have been observed for nonpoint sources of air toxics, which have suffered from chronic inattention and delays in issuing standards for more than a decade. U.S. ENVTL. PROT. AGENCY, OFFICE OF THE INSPECTOR GENERAL, KEY ACTIVITIES IN EPA'S INTEGRATED URBAN AIR TOXICS STRATEGY REMAIN UNIMPLEMENTED 5-6 (June 2010) (describing the regulatory delays and the failure to finalize standards for most area sources until after 2006); U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 157, at 23 (noting that "the challenges in regulating small stationary sources center on the difficulty in characterizing the large number of widely dispersed facilities . . . . [In addition,] owners and operators of these sources have limited resources to implement regulations and will require extensive outreach and compliance assistance").

210. Maximilian Auffhammer et al., *The City-Level Effects of the 1990 Clean Air Act*, 87 LAND ECON. 1, 5 (2011); *see also* NATIONAL RESEARCH COUNCIL, AIR QUALITY MANAGEMENT IN THE UNITED STATES 213 (2004) (noting that "the major impediment to making progress on area-source emissions arises from the large number of uncertainties associated with emission inventories for these sources. Specific challenges include the many sources in any given category and the wide variation in the conditions and operating practices under which the emissions can occur").

> high-quality inventory of such sources, it is nearly impossible to quantify their emission contributions and to set priorities. Yet, those few analyses that have been done . . . suggest that [nonpoint]-source emissions are significant and will be even more important [in the future].[211]

Industrial sources. While industrial sources typically account for a small fraction of most criteria pollutants, they dominate emissions for SO_2 and generate more substantial levels of NO_x, and $PM_{2.5}$. The fraction of industrial emissions effectively within the control of states, however, is also limited by federal programs. Electric utilities account for a majority of the industrial emissions of SO_2, but electric utilities are subject to direct federal regulation under several pollution trading programs.[212] State regulation of industrial sources is further constrained by the New Source Review (NSR) program, which covers new or modified industrial sources in nonattainment areas.[213] The NSR program has two components: (1) strict technology-based standards, which are set on a facility-by-facility basis by the state;[214] and (2) the requirement that new or modified sources offset their emissions of criteria pollutants.[215] Both provisions limit state discretion, but the offset requirements have had the greatest impact.[216] This is in part because offsets have a ripple effect that grows as the pool of low-cost offsets shrinks overtime, forcing industrial sources to purchase costly offsets or meet stringent restrictions while

211. NAT'L RESEARCH COUNCIL, *supra* note 210, at 212-14.

212. Potts, *supra* note 185, at 36-39.

213. 42 U.S.C. § 7503 (2012).

214. The federal NSPS program limits state discretion indirectly by operating as a minimum standard for facilities covered under the NSR and PSD programs. ROBERT J. MARTINEAU & DAVID P. NOVELLO, THE CLEAN AIR HANDBOOK 300 (2004).

215. In the most severely polluted areas, offsets in existing emissions must be greater than one-to-one. 42 U.S.C. §§ 7511, 7512, 7513 (2012). In practice, offsets are obtained through bilateral agreements with the owners of existing sources who have reduced their facility's emissions.

216. Interview with Joel H. Mack and Claudia M. O'Brien of Latham & Watkins (Feb. 15, 2013) [hereinafter Mack & O'Brien Interview] (describing shortages of offsets for VOCs in Houston and NOx and VOCs in Los Angeles). These attorneys have extensive experience obtaining CAA permits and offsets for major industrial facilities in California and Texas.

controls on motor vehicles and nonpoint sources remain relatively lax.[217]

Preemptive or overlapping federal regulatory authority compounds the political and administrative constraints to narrow dramatically the viable regulatory options for state agencies. The limits on state action can be roughly quantified: mobile and nonpoint sources alone account for most of the criteria pollutants emitted nationally—96 percent of CO, 68 percent of NO_x, 92 percent of VOC, and 83 percent of $PM_{2.5}$. If emissions from electric utilities are added to these totals, collectively this combination of sources accounts for roughly 85 to 95 percent of the key criteria pollutants emitted annually.[218] The end result is that most emissions of criteria pollutants are either effectively beyond state control or in practice have proven exceptionally difficult to regulate.[219] Moreover, these national averages represent lower bounds for most metropolitan areas suffering from poor air quality and in nonattainment for one or more NAAQS.

The influence of these structural and practical barriers is evident in empirical studies of the SIP implementation process. Several studies have analyzed correlations between the nonattainment status of a county and the rates at which air quality improves. While a few have found statistically significant correlations,[220] a representative finding is that nonattainment

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217. Mintz, *supra* note 21, at 183 (stating that the NSR offset requirement "makes it very difficult for new industry to locate in [extreme ozone areas]").

218. The specific percentages of aggregate emissions are as follows: 97 percent of CO, 87 percent of NO_x, 92 percent of VOC, 92 percent of $PM_{2.5}$, and 86 percent of SO_2.

219. The Bay Area Air Quality Management District in northern California is explicit about the jurisdictional limits of its regulatory authority. According to its 2010 Clean Air Plan, the district's regulatory authority covers 14 percent of NO_x emissions, 33 percent of VOCs, and 51 percent of $PM_{2.5}$; area sources account for roughly 43 percent of VOC emissions and 64 percent of $PM_{2.5}$ emissions. BAY AREA AIR QUALITY MANAGEMENT DISTRICT, BAY AREA 2010 CLEAN AIR PLAN 2-9 to 2-10, 2-15, 2-35 (2010), http://www.baaqmd.gov/Divisions/Planning-and-Research/Plans/Clean-Air-Plans.aspx.

220. Auffhammer et al., *supra* note 210, at 13-14 (finding that "nonattinament cities in nonattainment counties have a negative and statistically significant impact in explaining [reductions] in PM_{10}"); J. Vernon Henderson, *Effects of Air Quality Regulation*, 86 AM. ECON. REV. 789, 811-12

status is "responsible for only modest (and often not significant) reductions of ozone and [particulate matter]."[221] A more recent study suggested that county-level data may obscure significant reductions in metropolitan areas, but even this work found only that "nonattainment designations at the city level account for 7.2% of the drop in PM_{10}." At best, these studies present a mixed picture of whether nonattainment status has a material impact on improving air quality.

Several researchers have attempted to evaluate the relative importance of federal and state programs under the CAA.[222] These studies suggest that with the exception of California, which benefits from having the authority to set standards for motor vehicles, federal programs have generated most of the emissions reductions.[223] Focusing on regulation of ozone levels, researchers found that federal programs often accounted for 70 to 80 percent of the reductions in VOC emissions, but the

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(1996) (finding statistically significant correlations with daily maximum concentrations of ozone in July, but weak or statistically insignificant efforts for other measures of ozone levels); Kenneth Y. Chay & Michael Greenstone, *Air Quality, Infant Mortality, and the Clean Air Act of 1970*, NBER Working Paper 10053 31-34 (2003), *available at* http://www.nber.org/papers/w10053; Kenneth Y. Chay & Michael Greenstone, *Does Air Quality Matter? Evidence from the Housing Market*, 113 J. POL. ECON. 376, 400-01 (2005) (finding a statistically significant impact of nonattainment status on air quality of between 9 and 12 percent).

221. Auffhammer et al., *supra* note 210, at 2.

222. Two studies also evaluated the analytical methods used in the SIP planning process to assess pollution mitigation measures, and both found them to be deficient. Phillip M. Roth et al., *Air Quality Modeling and Decisions for Ozone Reduction Strategies*, J. AIR WASTE MGMT. ASS'N 1558, 1571-73 (2005) (finding that the majority of SIP planning processes had not performed adequate performance evaluations and had insufficient corroborating analyses); James D. Fine & Dave Owen, *Technocracy and Democracy: Conflicts between Models and Participation in Environmental Law and Planning*, 56 HASTINGS L.J. 901, 965-66 (2005).

223. Andrew H. Pegues et al., *Efficacy of Recent State Implementation Plans for 8-Hour Ozone*, 62 J. AIR WASTE MGMT. ASS'N 252, 255 (2012) (finding California state programs account for 100 percent of the reductions in NO_x and VOC emissions, but noting that "California presents an unique case here because . . . it alone has the ability to set its own mobile emissions standards"); NAT'L RESEARCH COUNCIL, *supra* note 210, at 217-19 (concluding that "[f]or most states, emission-reduction credits from federal control measures have represented a major fraction of the emission reductions in their respective SIPs").

percentages were more variable across the studies (25 to 100 percent) for NO_x emissions.[224] The general patterns elucidated by this work are captured well by a 2012 study in which the authors conclude that:

> The contribution of the SIP process to the improvements [in ozone levels] is unclear. Average improvements were steepest in nonattainment regions. However, among locations with similar ozone or NO_2 levels initially, those in regions facing the impetus of nonattainment did not experience dramatically sharper trends. This is consistent with the fact that, apart from California, the majority of emission reductions documented in SIPs resulted from federal measures.[225]

Finally, the impacts of state programs should be evident in the actual trends of emissions reductions. The data are consistent with the results discussed above. Reductions in emissions of $PM_{2.5}$ have been closely associated with major industrial facilities (i.e., electric utilities), with declines of 35-45 percent between 2000 and 2012, and nonroad motor vehicles, with a decline of 45 percent. By contrast, nonpoint sources achieved reductions of 14 percent over this same period.[226] The trends are even more skewed for NO_x and VOCs. Electric utilities, industrial boilers, and transportation sources accounted for 99 percent of the total reductions in NO_X emissions between 2000

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224. Pegues et al., *supra* note 223, at 255 (finding that, with the exception of California, federal programs typically account for 70 to 100 percent of the reductions in VOC and NOx emissions); NAT'L RESEARCH COUNCIL, *supra* note 210, at 217-19 (finding that, with the exception of California, federal programs account for 50 to over 90 percent of the reductions in VOC emissions and 25 to 60 percent of the reductions in NO_x emissions). In the NRC study, the state programs reduced NO_x almost exclusively through reductions from industrial sources (particularly in Texas) and enhanced inspection and maintenance programs, which as we have seen are of uncertain efficacy in practice.

225. Pegues et al., *supra* note 223, at 260. These findings are consistent with anecdotal accounts of SIP implementation. *See* Fine & Owen, *supra* note 222, at 946, 948 n.249, 959 (noting that regulatory officials in the San Joaquin valley "placed heavy reliance upon reductions from rules imposed by other regulatory entities").

226. The EPA longitudinal data on criteria pollutants do not utilize the conventional categories of point, nonpoint, onroad vehicles, and nonroad vehicles; their "miscellaneous" category is closest to the nonpoint class used for the National Emission Inventory data. This analysis uses "miscellaneous sources" as a proxy for nonpoint sources.

and 2012. Similarly, whereas emissions of VOCs from these sources declined by 55 percent over this period, emissions of VOCs from nonpoint sources increased by over 40 percent just between 2005 and 2012.[227] These findings—which must be read impressionistically because of changes in the EPA data over time—also suggest that the sources for which declines in emissions of criteria pollutants have been greatest (i.e., motor vehicles, electric utilities) are largely regulated under the federal programs.

The emissions data, the legal and practical constraints, and the studies of NAAQS implementation plans present a consistent picture of state programs. The emissions data highlight why the options available to states for reducing emissions are often foreclosed by a combination of jurisdictional, administrative, and political obstacles.[228] Recent empirical work is consistent with these results. It finds that direct federal regulations are responsible for much of the declines observed in ambient levels of criteria pollutants over the time periods studied and that the nonattainment status of an area has only a modest impact on these reductions. In short, the ongoing success of the CAA is largely attributable to direct federal regulation that states are mandated to implement as opposed to the statute's system of cooperative federalism.

B. Environmental Federalism and Public Choice Reconsidered

The empirical results discussed above are the foundation of the theoretical arguments made in this section. They

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227. Emissions from miscellaneous sources increased dramatically around 2003, but this was driven by a recalibration of EPA's emissions inventories. It is also worth noting that industrial processes, which include large and small sources, is the source category with the single largest share of VOC emissions (about 40 percent of the total); emissions from this class declined about 10 percent between 2000 and 2012.

228. These findings are also consistent with general critiques of the SIP framework. *See, e.g.*, Fine & Owen, *supra* note 222, at 938-70 (chronicling the failure of one SIP); Arnold W. Reitz, Jr., *Air Quality Protection Using State Implementation Plans—Thirty-Seven Years of Increasing Complexity*, 15 VILL. ENVTL. L.J. 209, 357-58 (2004) (characterizing the SIP process as a "failure" given that many areas remained in nonattainment).

demonstrate that the limited effectiveness of cooperative federalism has little to do with the regulatory pathologies, particularly those associated with public choice theory, typically cited by academics. The principal purpose of this section is to reexamine the academic debate over environmental federalism in light of its failure to adequately take into account the prominence of small sources of air pollution. I will argue that this oversight has led both to misapplication of public choice theory and to a neglect of other more important barriers to improving air quality. My normative claim is that the dominance of emissions from small sources changes the justifications for federal regulation and thus the role that it ought to play in protecting air quality.

The overreliance of the leading theories of environmental federalism on public choice theory is fundamental. For the classical school, the threats of agency capture by concentrated business interests and interstate competition over attracting large industrial plants are central to determining whether regulation should be elevated to the federal level. Within the dynamic school, they underlie its diversification strategy—favorable politics in one state can circumvent industry opposition in another state. The presumed importance of large industrial sources reflected in these theories mirrors the tendency of the general public and policymakers to single them out.[229] This predilection has been bolstered by the visibility of electric utilities[230]—no other industry figures as prominently in clean air policy,[231] nor does any other industrial source approach the emissions levels or impacts of coal-fired power plants.[232]

229. *See supra* pp. 319-321

230. This inverted perspective is reinforced by casebooks, which focus largely on NAAQS and regulation of major industrial sources. *See, e.g.*, HOLLY DOREMUS ET AL., ENVIRONMENTAL POLICY: PROBLEMS, CASES, AND READINGS 696-723 (discussing motor vehicle regulations primarily as an example of technology forcing); GLICKSMAN ET AL., *supra* note 8, at 490-96, 514 (motor vehicle policies covered in 7 pages out of more than 150 on the Clean Air Act).

231. The widespread impacts of coal-fired power plants prompted the creation of two major programs—protections for air quality in areas complying with NAAQS and the first pollution trading program, which regulated SO_2 emissions associated with acid rain. 42 U.S.C. §§ 7470-49, 7651 (2006).

232. Electric utilities account for a majority of the industrial emissions for

The continued focus on industrial emissions not only marginalizes collectively more important sources of air pollution, it obscures the barriers to regulating diffuse sources that differ from those of large industrial facilities.[233] Traditional concerns about interstate competition and agency capture simply do not apply to residential sources or transportation planning. Similarly, the risk of interstate "races to the bottom" will be minimal for small businesses, as they lack the economic leverage of large companies—threats to leave will be either implausible or neutralized by the presence of numerous local competitors. Nor do small businesses with collectively significant emissions (e.g., metal coating/paint shops, dry cleaners, restaurants) fit the conventional public choice model of "concentrated business" interests with high stakes in opposing regulations.[234] The threat of agency capture in this context is, by definition, diminished given the number and heterogeneity of entities affected.

The primary barriers to regulating small sources involve a

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three key criteria pollutants regulated under the NAAQS program, whereas no other industry accounts for more than a few percent. *See supra* pp. 287-288.

233. Emissions from nonpoint sources are fragmented across a broad range of residential and commercial sources. The EPA data show that in the major urban centers, where nonpoint sources are most highly concentrated, single classes of businesses account for less than 20 percent of the cumulative emissions from nonpoint sources at the county level. The exceptions to this general rule are rare. Representative examples include emissions of $PM_{2.5}$ from restaurants and construction in several major cities, and emissions of VOCs from surface-coating companies in Chicago and from waste disposal sites in New York City. (Surprisingly, gas stations in the largest urban centers account for less than 10 percent of cumulative VOC emissions from nonpoint sources—except for Houston, where they account for about 12 percent of the total.)

234. *See, e.g.*, Revesz, *Federalism and Environmental Regulation*, *supra* note 2 at 559 (describing the public choice dynamics as involving the adoption of "suboptimally lax environmental standards because industry groups that favor less stringent regulation are small and cohesive, whereas individuals who support more stringent regulation are a larger and more diffuse group"); Stewart, *supra* note 1, at 1213 ("Industrial firms, developers, unions and others with incentives to avoid environmental controls are typically well-organized economic units with a large stake in particular decisions"); Kirsten H. Engel & Scott R. Saleska, *"Facts Are Stubborn Things": An Empirical Reality Check in the Theoretical Debate Over the Race-to-the-Bottom in State Environmental Standard-Setting*, 8 CORNELL J.L. & PUB. POL'Y 55, 64 (1998) (observing that "laws tend to respond to the wants of small, cohesive special interest groups, such as industry, at the expense of the wants of the larger, more diffuse public").

distinct set of political and administrative challenges. As shown above, opposition to transportation policies and regulating small sources is often driven by resistance to undesirable or costly policies that impact the general public (e.g., fuel taxes, parking restrictions, regulation of woodstoves/fireplaces) or small businesses such as dry cleaners and restaurants.[235] Transportation planning and controlling emissions from residential sources, for example, implicate expensive infrastructure or entrenched expectations that are difficult to overturn through rules and sanctions alone.[236] Absent effective public outreach, regulations that run counter to established norms are much more likely to incite public opposition, and regulatory standard setting and enforcement often will be harder given the number, diversity, and diffuse nature of small sources.

Implementing regulations may be further aggravated by economic factors, such as limited access to capital, higher relative costs of emissions controls, absence of economies of scale, and the limited technical knowledge of the general public and small-business owners.[237] Acceptance of new products or policies in this "retail" context frequently does not turn on narrow utilitarian criteria.[238] This phenomenon lies at the center of academic work on adoption rates of new innovations and methods, which can vary dramatically regardless of their objective utility or social value.[239] Existing norms, misperceptions, heuristic biases, structural impediments, and

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235. *See supra* note 208 and accompanying text; NAT'L RESEARCH COUNCIL, *supra* note 210, at 212-14; Wahrman, *supra* note 21, at 191-92.

236. EVERETT M. ROGERS, THE DIFFUSION OF INNOVATIONS 26 (5th ed. 2003) (observing that norms can be a major barrier to adoption, as they "define a range of tolerable behavior and serve as a guide or standard for the behavior of members of a social system").

237. The efforts to promote the adoption of low-toxicity, water-based dry cleaning provide a compelling example of the added complexities often entailed in regulating small businesses. *See* Timothy F. Malloy & Peter Sinsheimer, *Innovation, Regulation and the Selection Environment*, 57 RUTGERS L. REV. 183, 189 (2004).

238. ROGERS, *supra* note 236, at 221.

239. *Id.* For example, despite both being objectively revolutionary, anesthesia was embraced immediately by surgeons whereas antiseptic techniques took decades before they were widely adopted. Atul Gawande, *Slow Ideas*, THE NEW YORKER, July 29, 2013, at 36, 37.

misalignment with perceived needs can stall adoption even of innovations that are later universally acknowledged to be of transformative value.[240]

Clean air policies have attributes that make it especially difficult to overcome these forms of resistance.[241] The benefits of discrete policies will be difficult to discern given the number of sources, and improvements in air quality are typically subject to significant time lags.[242] The compatibility of policies with public values and experience may also be mixed, as they implicate competing values (e.g., freedom of movement, control over one's home) and the most salient associations with air pollution involve industrial facilities. Clean air regulations are also mind-numbingly complex, which impedes public understanding and thus acceptance. Together these barriers create a high threshold for states and local governments to persuade the public that regulation of small sources is necessary and worth the trouble.

Finally, whereas regulation of industrial sources is centralized in state-level agencies, transportation planning and regulation of nonpoint sources are heavily reliant on local governments.[243] Transportation planning, in particular, involves a mix of local, state and federal agencies, and it occurs on timescales that are often out of sync with clean air policies.[244] This fragmentation of

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240. Gawande, *supra* note 239, at 39. The critical point here is that the barriers are customary, structural, and psychological, as opposed being associated with environmental externalities or inadequate innovation.

241. The primary factors that influence acceptance of new policies include (1) the relative benefits; (2) compatibility with existing public values, past experiences, and needs; (3) the degree to which they are perceived as difficult to understand and implement; (4) whether they can be experimented with on a limited basis; and (5) whether the results of a policy are observable. ROGERS, *supra* note 236, at 15-17, 221-23.

242. *Id.* at 223, (noting that the "immediacy of reward" is a significant part of "relative advantage," which "explains in part why preventive innovations generally have an especially slow rate of adoption"). The value of small-scale experiments is of limited values for similar reasons. *Id.*

243. Melnick, *supra* note 102, at 308 (noting that "[w]hile the EPA can threaten privately owned stationary sources with fines and jail sentences, transportation policies result from the interaction of a large variety of government units, none solely responsible for these policies and few subject to traditional legal sanctions"); Wahrman, *supra* note 21, at 191-92; Mintz, *supra* note 21, at 167, 191; HARRINGTON ET AL., *supra* note 21, at 18.

244. Melnick, *supra* note 102, at 308.

regulatory authority complicates oversight—no single entity is responsible—while the number and variety of regulated actors can overwhelm agency capacities and make effective enforcement politically untenable. Thus, while federal and state agencies can ultimately issue regulations over the objections of regulated industries, the history of clean air laws demonstrates that regulations significantly impacting the public and small businesses are typically much harder to implement by legal fiat.[245]

Consideration of the barriers described above is largely absent from the leading theories of environmental federalism. For the classical school, the primary consideration is whether regulatory agencies internalize the environmental costs and benefits of their policies.[246] Under this theory, the case for the NAAQS and its system of cooperative federalism would be tenuous, as the leading sources with interstate impacts (motor vehicles, electric utilities) are subject to direct federal regulation.[247] At the same time, the other notable exceptions to the matching principle—regulatory races to the bottom and agency capture—either don't apply to small sources or are of secondary importance.[248]

The regulatory impediments associated with small sources also expose the shortcomings of the classical theory's focus on negative externalities. For example, the need to change public attitudes and to persuade small business owners, both of which are facilitated by peer-to-peer interactions, favor regulation at

245. ROGERS, *supra* note 236, at 221-23; U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 157, at 23 (noting that "the challenges in regulating small stationary sources center on the difficulty in characterizing the large number of widely dispersed facilities . . . . [In addition,] owners and operators of these sources have limited resources to implement regulations and will require extensive outreach and compliance assistance").

246. Stewart, *supra* note 1, at 1215; Butler & Macey, *supra* note 192, at 25; Revesz, *Race-to-the-Bottom*, *supra* note 1, at 1222.

247. Wallace E. Oates, *An Essay on Fiscal Federalism*, 37 J. ECON. LIT. 1120, 1122-24 (1999) (arguing that in the absence of inter-jurisdictional spillovers the local governments are in a superior position to provide public goods).

248. In fact, public choice theory can be flipped on its head—the number of people impacted can be a virtue when the impacts of regulations are sufficient to prompt unilateral individual action and widespread. The long history of inaction on transportation planning is, in part, a testament to this phenomenon.

the local level.[249] However, the benefits of such programs will not be solely local. Successful state-level programs will generate knowledge spillovers and influence regulation in neighboring states,[250] which only the federal government will have a consistent interest in facilitating.[251] The need for federal support is all the more important given the technical nature of such programs, the substantial investments they often require (e.g., costly infrastructure), and the public ambivalence towards them.

Dynamic federalism falters by both marginalizing small sources and presuming that regulatory innovation is inherent to an open federalist system.[252] In particular, the heterogeneity of local conditions, upon which dynamic federalism is premised, overlooks the commonalities of areas with the lowest air quality and thus the greatest incentives to innovate—high urban density, lack of essential infrastructure, and a predominance of diffuse sources. The persistent obstacles to controlling air pollution in urban areas are reflected in the history of clean air policy. Urban smoke (also associated with small sources) resisted regulation for decades, and in the end its decline was attributable more to the availability of new fuels (natural gas, diesel) than to regulation.[253] Likewise, transportation policies today have failed in large part because of political and structural barriers in the urban centers where they are most needed.[254] The pervasiveness of these obstacles undercuts the geographic diversity on which dynamic federalism is premised and stalls

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249. ROGERS, *supra* note 236, at 18-19 (asserting that acceptance of policies is "a very social process" because most individuals "depend mainly upon a subjective evaluation of . . . other individuals like themselves," who have similar "beliefs, educations, and socioeconomic status").

250. Oates, *supra* note 247, at 1133; ROGERS, *supra* note 236, at 283 (describing how "early adopter decreases uncertainty about a new idea by adopting it, and then conveying a subjective evaluation [it]"). Studies of policy diffusion have also found that "[t]he most innovative regional governments tended to influence their neighbors." *Id.* at 297.

251. Oates, *supra* note 247, at 133-34.

252. Buzbee, *supra* note 193, at 122-26; Engel & Saleska, *supra* note 195, at 190.

253. *See supra* pp. 248-250.

254. HARRINGTON ET AL., *supra* note 21, at 16 (finding strong evidence for "heighten[ed] concern about a toolkit empty of ways to meet transportation needs and air quality goals").

adoption of innovative policies.

The gaps in the leading schools of federalism highlight their complementary perspectives. The classical theory is a useful framework when the primary goal is static efficiency and the regulatory options are well established; the dynamic theory is most useful when developing new policies or when experimenting with new technologies is the primary objective and sufficient heterogeneity of local conditions (i.e., political, socioeconomic, environmental) exists nationally. Neither theory addresses the distinctive political and systemic barriers that are endemic to regulating small sources of air pollution, which fail to fit consistently within the framework of the matching principle under the classical theory or to generate the local experimentation and model programs on which the dynamic theory is premised.

The preceding arguments are reinforced by the heterogeneity across small sources of air pollution. Small sources with collectively the largest emissions can be grouped into four basic categories: (1) consumer products (solvents, paints, cleaning products); (2) residential combustion (woodstoves, fireplaces, water heaters); (3) small businesses (dry cleaners, metal coating/paint shops, restaurants, waste disposal sites);[255] and (4) transportation-related (vehicle-miles travelled not emissions rates). These categories encompass or implicate public and commercial behavior, products used locally but sold in national markets (solvents, woodstoves, commercial dry-cleaning equipment), and decisions involving local transportation and infrastructure (municipal zoning, highways, public parking). This variability further highlights the pitfalls of basing theories of environmental federalism on industrial sources.

My principal objective in this section has been to show that barriers to regulating small sources differ in kind from those

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255. Gas stations are collectively a significant source of volatile organic compounds and air toxics, but most of the emissions derive from evaporation of gasoline at the pumps and are largely covered by federal regulations. Evaporative losses are controlled through federal fuel standards (e.g., limits on benzene and sulfur content) and technology-based standards on motor vehicles that limit releases from gas tanks during filling.

commonly associated with large industrial sources and that the leading theories of environmental federalism do not adequately consider them. This oversight has led academics and policymakers to overstake their claims for direct federal regulation, including industrial sources, and to misapprehend the most compelling reasons for federal intervention. Both problems stem from a heavy reliance on public choice theory that ignores the predominance of small sources and the influence of competing regulatory constraints on state policies. Perhaps most striking, the long history of clean air policy suggests that barriers to regulation of small sources, both political and administrative, often trump the public choice advantages of large industries.

The prominence of small sources has direct and indirect implications for regulatory policies at the state and federal levels.[256] I will highlight three, two of which will be discussed in the next section. First, with the important exception of motor vehicles, the literature on clean air policy has ignored emissions from consumer products (e.g., cleaning products, paints, woodstoves, water heaters), and thus undervalued the unique role the federal government can play in setting national product standards to mitigate air emissions. Second, the persistent barriers described above to development and diffusion of effective transportation policies and small-source regulations highlights the need for targeted federal programs to generate model policies (e.g., incentives, funding, technical support). EPA could also be given the authority, which it currently lacks, to condition approval of state plans on the adoption of pilot projects to facilitate diffusion of such model policies. Third, the low relative and absolute levels of emissions from industrial sources, factors mitigating public choice dynamics, and interest in enhancing state discretion under cooperative federalism, suggest that federal regulation of major industrial sources under the

256. None of the observations made here alter the case for federal regulation of sources, most notably motor vehicles and coal-fired power plants, with significant interstate impacts. Other than the specific form of regulation, however, federal intervention on this ground has never been a significant source of controversy in academic or policy debates over environmental federalism.

PSD and NSR programs could be ended or streamlined without detrimentally impacting human health. I would limit this third proposal to use as part of a legislative compromise to achieve reforms necessary to address climate change and to revitalize the pollution-trading regimes for electric utilities.

IV.
REALIGNING CLEAN AIR POLICY TO REFLECT THE IMPORTANCE OF SMALL SOURCES

Clean air policies cover a broad mix of sources and pollutants with impacts that range from the local to the global. This heterogeneity is a primary reason that restricting regulations to a single level of government has been contested. There are other respects, however, in which air pollution follows relatively simple patterns. Geographically, the areas with the lowest air quality are centered around major urban centers. In addition, certain types and classes of sources dominate air emissions, and a handful of pollutants account for a great majority of risks to human health. In short, air pollution is closely associated with a limited number of geographic areas, source types, and pollutants.

Implementation of the NAAQS program and preserving state discretion under cooperative federalism are shaped by these broad patterns. Although direct federal regulation of motor vehicles and electric utilities appropriately targets interstate sources of air pollution, it unavoidably bounds the scope of cooperative federalism under the NAAQS program by effectively removing a large fraction of total emissions from state control. State programs in urban areas are constrained further by the political and administrative challenges posed by the remaining sources and control strategies (i.e., nonpoint sources, transportation planning). Policies that ignore these structural and practical limits, such as the analyses required to demonstrate compliance with the NAAQS, can end up forcing federal and state agencies to devote limited resources to elaborate modeling exercises that have little value other than to satisfy formulaic regulatory obligations.[257]

Proponents of the NAAQS may concede that state implementation is inadequate, but they blame the EPA or state agencies for a failure of resolve without acknowledging the systemic constraints. My worry, and a central motivation for this Article, is that empirically unexamined beliefs about the NAAQS—their impacts on emissions, technology, and interstate competition—have become dogma that is reinforced by a view held among many environmental advocates that any perceived rollbacks in policies must be opposed. This perspective, although understandable in the current political climate, makes it exceedingly difficult to identify opportunities for compromise that I believe will be a precondition to needed reforms of the CAA and to addressing the pressing issue of climate change. With an acute sense of their likely divisiveness, the reforms I propose below are advocated as empirically and normatively grounded opportunities to strengthen the CAA and to enable compromises, with few environmental downsides, that will be essential to broader reforms on issues such as climate change.

This section outlines two sets of reforms that rebalance clean air policies in light of the importance of small sources. First, the CAA's system of cooperative federalism will continue to underperform unless it is refocused on stimulating the development of effective state-level and local policies. In short, rather than spreading resources across all jurisdictions failing to attain a NAAQS, greater emphasis should be placed on targeted funding of demonstration projects and facilitated transfer of proven policies nationally. Second, federal regulation of major industrial sources under the NSR and PSD programs skews regulatory priorities and unnecessarily limits state authority to select policies and allocate emissions across sources. Although undoubtedly controversial, a proposal to end these programs could be used, for example, as part of a political compromise for broader reforms to address climate change and to strengthen pollution trading programs for electric utilities without

257. WILLIAM CHAMEISES ET AL., NATIONAL RESOURCE COUNCIL, QUALITY MANAGEMENT IN THE UNITED STATES 126 (2004); Roth et al., *supra* note 222, at 1558.

negatively impacting human health.

A. Reforming NAAQS Planning and Implementation Processes

It is important to appreciate that the disparities across the country in air quality and challenges of meeting the NAAQS in urban areas were a source of conflict from the outset. In 1970, Congress initially left no room for balancing of any sort when it set unrealistic compliance deadlines and precluded EPA from considering costs when setting the NAAQS.[258] The law put regulators in the dubious position of either setting a standard that it knew could not be met by the statutory deadlines in most highly populated areas or issuing a weaker standard than the science alone warranted. Regardless of the outcome, EPA's judgment was vulnerable to attack—either based on claims that its standards could not be met or that it had sacrificed science to political or economic expediency.[259]

A political compromise was struck in 1977, and expanded in the 1990 Amendments, that finessed the tensions in the law by adopting a schedule of staggered compliance deadlines.[260] The NAAQS consequently are not, and have never been, national

258. 42 U.S.C. § 7409(b)(1) (2012).

259. *See, e.g.*, CHAMEISES ET AL, *supra* note 257, at 129 (observing that "[s]etting unrealistic deadlines can lead to frustration for local and federal agencies that do not see any reasonable way to achieve the requirements of the act. It can also introduce an aura of fiction to the entire SIP process"); Quarles, *Transportation Control Plans*, *supra* note 9, at 242 (concluding that unrealistic requirements of the CAA "caused extraordinary turmoil to achieve little benefit and that in so doing the [transportation control plans] contributed substantially to the backlash of objection to regulation in general"); Coglianese & Marchant, *supra* note 127, at 1291-29 (complaining that "EPA's use of science as a rhetorical defense helped to mask the absence of a coherent, principled account for why the Agency revised its ozone and particulate matter standards as it did").

260. Ozone nonattainment areas were divided into five categories, each with a distinct compliance date and requirements for annual reductions in pollution levels. 42 U.S.C. § 7511a(b)(1) (2012). Attainment areas for CO and PM_{10} were, or could have been in the case of PM_{10}, divided into two categories (marginal and serious). 42 U.S.C. §§ 7512(a)(1), 7513(a)-(b) (2012). They also imposed enhanced requirements for certain nonattainment areas based both on the severity of pollution and population levels. 42 U.S.C. § 7511a(c)(3) (2012).

standards in practice—a point often elided in current debates.[261] Staggering the compliance deadlines, however, did not quell controversies over the NAAQS, as illustrated most recently by the Obama Administration's decision in 2011 to delay issuance of a revised standard for ozone.[262] Instead, the NAAQS retain the veneer of national standards, and the heightened political and economic stakes that follow, without truly operating as uniform standards. This was, of course, precisely the bargain that everyone struck. States were given time, as it turned out decades, to comply with the NAAQS while environmentalists agreed to bend on deadlines but not on the goals—they wished to "keep [the] goals out of reach to put constant pressure on regulators and polluters."[263]

This was arguably a logical strategy when industrial emissions represented a larger fraction of overall emissions and many opportunities existed for reductions. However, we do not now live (and may never have lived) in a world in which the battle is primarily a political one between industrial interests and public advocates. Air pollution is largely a problem for which we are collectively responsible. The practical consequences of setting unrealistic goals is evident in the SIP implementation process, which operates primarily to satisfy the required showing that state policies will lead to timely NAAQS compliance.[264] A recent National Research Council report highlighted this issue when it characterized the process for developing SIPs as "overly bureaucratic":

> The SIP process now mandates extensive amounts of local, state, and federal agency time and resources in a legalistic, and often frustrating, proposal and review process, which

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261. Harrison & Portney, *supra* note 27, at 26.

262. President Barack H. Obama, *Statement by the President on the Ozone National Ambient Air Quality Standards* (Sept. 2, 2011), http://www.whitehouse.gov/the-press-office/2011/09/02/statement-president-ozone-national-ambient-air-quality-standards.

263. MELNICK, *supra* note 102, at 363.

264. Wahrman, *supra* note 21, at 191 (concluding that "[t]he SIP has proven to be an ineffective tool to improve air quality as highway construction and other local projects that may increase total emissions go forward and are incorporated in the SIP").

> focuses primarily on compliance with intermediate process steps . . . . This process probably discourages innovation and experimentation at the state and local levels; overtaxes the limited financial and human resources available to the nation's [air quality management] system at the state, local, and federal levels; and draws attention and resources away from the more germane issue of ensuring progress toward the goal of meeting the NAAQS.[265]

Consistent with these concerns, a survey conducted by Resources for the Future found that many state officials expressed concern about the time that must be dedicated to the SIP process.[266] Moreover, beyond the costs and time for regulators, the duration of the SIP process and the litigation surrounding it can cause significant delays in abatements actions.[267]

Realistically, it is difficult to imagine a political realignment that would allow for constructive reconsideration of national standards in their current form. Whatever the limits in practice, advocates have long viewed the NAAQS as EPA's primary means of pressuring states to take action.[268] Reforms must therefore work within the existing framework to empower state-level efforts to control emissions from *all* sources. Recognition that conventional threats to state action—interstate competition and agency capture—either will not apply or will be less significant for small sources and that the greatest obstacles to effective policies are systemic has the potential to lower opposition to

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265. CHAMEISES ET AL, *supra* note 257, at 128.

266. HARRINGTON ET AL., *supra* note 21, at 9, 30 (discussing the frustration of air quality planners associated with "time-consuming SIP revisions [for which] the actual air-quality benefits . . . may be minimal"); U.S. GOV'T ACCOUNTABILITY OFFICE, FEDERAL PLANNING REQUIREMENTS FOR TRANSPORTATION AND AIR QUALITY PROTECTION COULD POTENTIALLY BE MORE EFFICIENT AND BETTER LINKED 4 (April 2003) (describing the view among transportation planners that "the frequency with which they must [demonstrate conformity with SIPs] limits the time and funds available to address other important transportation challenges, such as alleviating congestion and ensuring highway safety").

267. Pegues et al., *supra* note 223, at 253 (describing the elaborate nature of the SIP process and the many sources of delay, often upwards of a decade, that can impede abatement efforts).

268. Melnick, *supra* note 102, at 363.

limited reforms. This altered understanding (and decades of delays) could usefully weaken the prevailing faith in fixed statutory deadlines—the former challenges the need for them, the latter their efficacy.

The arbitrary and porous nature of statutory deadlines ought to reduce opposition to reform. Specifically, EPA could be given the authority to set NAAQS compliance deadlines, and to offset environmentalists' concerns about lost leverage, to condition SIP approval on adoption of specified programs with demonstrated records of success. The freedom from arbitrary deadlines would enable the SIP process to shift from serving bureaucratic ends to a focus on identifying viable policies, innovative programs, and jointly agreed-upon compliance schedules. EPA's role, in particular, would no longer be limited to emissions accounting and verifying the technical validity of a SIP. This enhanced authority could be complemented and further leveraged by expanding EPA involvement in and resources for facilitating demonstration projects of promising policies through grants or other incentive-based programs.[269]

The flexibility inherent in this proposal represents less of a departure from the status quo than someone leery of such reforms might initially infer. The CAA requires states to inventory sources of criteria pollutants and to derive model-based estimates of the reductions needed to meet the NAAQS.[270] This information is used by the state to set emissions limits, which are incorporated into the SIP, for any source of criteria pollutants. EPA's oversight is limited to determining whether proposed emissions limits will meet the NAAQS within the applicable statutory deadline.[271] However, the complexity of the underlying analysis entails technical judgments that can be outcome determinative.[272] These discretionary judgments afford

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269. The now moribund Integrated Urban Air Toxics Strategy is a potential model for this kind of program, particularly as the areas with the worst air quality are overwhelmingly urban. *See, e.g.*, U.S. ENVTL. PROT. AGENCY, NATIONAL AIR TOXICS PROGRAM: THE INTEGRATED URBAN STRATEGY 1-2 (2000).

270. Bachmann, *supra* note 9, at 686-87; 42 U.S.C. § 7410(a)(2) (2012).

271. KRIER & URSIN, *supra* note 5, at 174-75.

272. Fine & Owen, *supra* note 222, at 923-24, 930-31; David Owen, *Probabilities, Planning Failures, and Environmental Law,* 84 TUL. L. REV. 265,

state regulators numerous opportunities to manipulate results (often with EPA's apparent blessing) to avoid SIP requirements that would be politically unpopular or difficult to implement.[273] Accordingly, states already have substantial latitude to circumvent the NAAQS deadlines through arcane technical judgments inherent in the SIP process.

Trading off porous statutory compliance deadlines for EPA authority to condition SIP approval on specific actions therefore could strengthen EPA's ability to induce state action. It would also allow compliance deadlines to be set based on local conditions and through an open—and more transparent—rulemaking process that reduces the incentives to obscure policy choices in technical judgments. Indeed, by reframing the public debate around compliance dates, this approach could increase public involvement, as the highly technical nature of the SIP review process has been a significant barrier to public participation.[274] Public debates over the NAAQS would focus on two primary decision points—the setting of ambient standards, which would occur nationally, and the determination of compliance deadlines, which would occur at the state or possibly local level.

This proposal replaces a putatively fixed system of tiered compliance deadlines with a process that openly allows for local

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283-84 (2009) (describing the unavoidable uncertainties in air pollution modeling and the weak standards EPA uses for using modeling to demonstrate compliance with NAAQS).

273. Fine & Owen, *supra* note 222, at 930 (stating that "air quality models have consistently overestimated air quality gains, and most ozone SIPs . . . have not yielded attainment"); Bachmann, *supra* note 9, at 686 (describing studies conducted in the late 1980s that found SIPs were undermined by "inadequate assumptions regarding 'rule effectiveness' and poor enforcement," as well as "the development of 'cheater SIPs' that were encouraged by unreasonable deadlines"); David Shoenbrod, *Goals Statutes or Rules Statutes: The Case of the Clean Air Act*, 30 UCLA L. REV. 740, 771-74 (1983) (observing that "EPA bent over backwards to approve whatever plans the states submitted"); McGarity, *supra* note 118, at 77-78 (describing EPA failure to enforce the 1996 fifteen-percent emissions reduction targets for VOCs).

274. Fine & Owen, *supra* note 222, at 957, 967-68 (observing that "there was an almost complete absence of public participation from public interest groups or from the general public" regarding the approval of a SIP for the central valley in California).

calibration of compliance schedules. In doing so, it simultaneously recognizes the systemic constraints on states and seeks to augment EPA authority (and discretion) to promote state action. Beyond enhanced transparency, the principal gain would be greater strategic leveraging of limited resources and targeted development of programs that have a realistic chance of succeeding and serving as models for other states and localities. The gaps in enforcement noted above and limited effectiveness of the NAAQS program suggest that the leverage lost by abandoning statutory deadlines is likely to be modest. To the contrary, the history of clean air policy has demonstrated time and again that deadlines cannot prevail over widespread opposition; the only real option is to engage the public and to foster their acceptance of policies by demonstrating their value. This will be far from easy, but policies that fail to take into account structural limits associated with the principal sources of air pollution and constraints on government capacities waste limited resources and provide false hopes.

B. Reevaluating the Rationales for the NSR and PSD Programs

The PSD and NSR programs were originally enacted to supplement the NAAQS and to mitigate geographic disparities in regulatory burdens.[275] Today support for the PSD and NSR programs centers on heightened concerns about major sources of air pollution, particularly the potential for localized hotspots or interstate transport of air emissions, as well as the technology-forcing benefits and relative ease of administering the provisions that utilize technology-based standards.[276] I will argue that the

275. Legislators in 1970 had multiple grounds for supporting them, including fears about the adequacy of the NAAQS (spurred by the recognition that many pollutants are harmful at any level of exposure), a belief that strict controls favored economic development (lower emissions individually would allow for a greater number of facilities), the limited capacity of SIPs to address interstate air pollution, and the capacity of technology-based standards to promote innovation and deployment of new technologies. Melnick, *supra* note 102, at 81.

276. *See, e.g.*, Wendy E. Wagner, *The Triumph of Technology-Based Standards*, 2000 U. ILL. L. REV. 83 (2000); Sidney A. Shapiro & Thomas O.

prevailing rationales are either overstated, because the potential effects on pollution levels will be modest, or wrong about the risks associated with the vast majority of industrial sources. There are two exceptions to these claims, both of which have been already highlighted as outliers—coal-fired power plants and the massive industrial complex in the Houston area. I will address each of them separately, but suffice it to say that I believe other measures would be more effective than the PSD and NSR programs.

The evolution of regulations for industrial facilities provides a valuable perspective on the shifting rationales and contingencies motivating their enactment. Regulators originally adopted technology-based standards for industrial sources because scientists had little understanding of either the health or environmental impacts caused by air pollution. Policymakers in St. Louis selected them as a logical alternative to a risk-based approach in the 1930s, and regulators in Los Angeles resorted to them again when smog first emerged as a major problem in the 1940s.[277] Municipal agencies in both cases initially targeted large industrial facilities, and only later (after overcoming public opposition) began regulating smaller stationary and mobile sources. Federal regulation did not follow this trajectory; motor vehicles were regulated first, but industrial sources soon became a central focus of federal policies.

Congress's decision to single out industrial facilities for direct federal regulation was informed by its national perspective. The NSPS program adopted under the 1970 Amendments to the CAA was prompted, above all, by concerns about regional economic competition. Members of Congress feared that strict local regulations, which it assumed would be required to meet the NAAQS in large urban centers, would create strong incentives for industries to relocate to less-populated areas with good air

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McGarity, *Not So Paradoxical: The Rationale for Technology-Based Regulation*, 1991 DUKE L.J. 729 (1991).

277. STRADLING, *supra* note 36, at 164-65, 167-71; UEKOETTER, *supra* note 37, at 160 (noting that governments officials "had no choice but to take technological possibilities as their starting point" due to limited knowledge of the risks); KRIER & URSIN, *supra* note 5, at 60-61, 66.

quality.[278] The NSPS program was designed to mitigate inter-jurisdictional regulatory disparities by establishing minimum standards for high-impact industrial sources that would apply regardless of the local conditions.

The PSD and NSR programs codified in the 1977 were spurred by a complex array of issues. The PSD program emerged originally from a suit brought by the Sierra Club, while the NSR program was prompted by a latent statutory ban on construction of major sources in nonattainment areas. Congressional concerns about the citing of coal-fired power plants in pristine areas of the west were an overriding motivation for the PSD program, whereas NSR was premised on protecting local air quality without unduly impeding economic development.[279] In addition the PSD technology-based standards, though less stringent, also partially offset the NSR standards by easing potential regulatory imbalances between nonattainment (largely urban) and attainment (typically rural) areas.

Today, neither apprehensions about local air quality nor concerns about regional regulatory disparities provide firm grounds for either program. Setting aside electric utilities,[280] the primary reason is that industrial emissions of criteria pollutants have declined dramatically over the intervening years and now constitute a small proportion of overall emissions nationally—8 percent of VOCs and $PM_{2.5}$, 12 percent of NO_x, and 14 percent of SO_2.[281] Moreover, while these percentages are national averages, they are broadly representative of non-utility industrial emissions at the county level.[282] As a consequence, even with

278. *See supra* pp. 249-251.

279. *See supra* pp. 261-264.

280. Importantly, coal-fired power plants are subject to separate federal regulations under the SO_2 and NO_x trading programs, which account for most of the observed declines in emissions of these criteria pollutants from electric utilities. *See supra* p. 264.

281. By comparison, electric utilities collectively emit 66 percent of SO_2, 18 percent of NO_x, 9 percent of $PM_{2.5}$, and 0.24 percent of VOCs.

282. Even in the Houston area, which is an extreme outlier nationally with respect to the size and number of industrial facilities in the surrounding county, emissions from non-utility industrial sources in 2005 were a quarter of total emissions or less in all but one case—18 percent of NO_x emissions, 22 percent of VOC emissions, 25 percent of $PM_{2.5}$ emissions, and 50 percent of SO_2 emissions.

conservative assumptions about scientific uncertainties,[283] the risks associated with industrial facilities, including the likelihood of localized hotspots, are low because emissions levels bound the magnitude of the potential impacts.[284]

The underlying intuition here is that continued federal regulation is not warranted when emissions from industrial sources reach a level that is sufficiently low, both in relative and absolute terms. Put differently, once industrial sources account for a minor share of overall emissions, neither local risks nor interstate transport of pollutants would justify federal intervention; instead, states should decide how to allocate emissions between sources in their jurisdiction. The implied preference for state regulation, which is embraced by the two leading theories of environmental federalism,[285] derives from the fact that local policies can be better calibrated to reflect local conditions, which the EPA data show vary dramatically, and public values. Further, to the extent that concerns about public choice dynamics persist, the history of clean air policy suggests that pressures to reduce emissions from industrial sources will be as strong as, if not stronger, than those for other categories of sources.

The threat of regulatory imbalances to local economic development is also mitigated by the modest levels of emissions from most industrial facilities. When industrial sources, on average, *collectively* account for less than 15 percent of the criteria pollutants emitted, compliance with NAAQS alone is

283. While scientific uncertainties persist, each criteria pollutant has been studied extensively and the available science has been subjected to extensive peer review. Bachmann, *supra* note 9, at 680-81.

284. Similar arguments hold for most air toxics, which typically pose greater concerns about localized hotspots. An earlier article of mine examines these issues in detail and, drawing on extensive EPA data, shows that industrial emissions of air toxics in the vast majority of counties and census tracts are low in both absolute and relative terms; the few exceptions to this rule are strongly associated with emissions from steel mills and foundries. Adelman, *supra* note 149, at 47-48. Other factors also mitigate the risks, particularly that the most pervasive criteria pollutant, ozone, has a long atmospheric lifetime and is generated indirectly (through reactions of NO_x, VOCs and sunlight), both of which reduce the likelihood that ozone levels will be significantly elevated around large sources.

285. *See supra* notes192-195 and accompanying discussion.

unlikely to foreclose construction (or modification) of individual facilities—the impacts will be *de minimis*, particularly given the uncertainties inherent to air pollution models. The observation that Houston, with its outsized industrial base, is among the fastest growing centers for large industries further undercuts fears about regulatory disparities redirecting economic development.[286] This apparent insensitivity to local conditions may be influenced by the counterbalancing effects of the PSD and NSR programs, but my own sense (the econometric studies are mixed) is that other economic considerations dominate.[287]

The stability of major industrial centers across the country is further evidence that regulatory disparities are of secondary importance. Setting aside electric utilities, many of the industries with the largest emissions of criteria pollutants are clustered in certain areas—petrochemical plants in California, Illinois, Louisiana, and Texas; iron and steel manufacturing in Pennsylvania and Alabama; and chemical manufacturing in Texas, Louisiana, and Illinois.[288] This phenomenon is broadly recognized by economists as reflecting the positive spillovers associated with collocating businesses that lock in patterns of industrial development.[289] The persistence of these patterns and

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286. *See supra* Part II.D.

287. Numerous studies have been conducted to assess the impact of environmental regulations on the location of industrial facilities, including a number that focus on air quality issues and attainment status in particular. *See, e.g.,* Smita B. Brunnermeier & Arik Levinson, *Examining the Evidence on Environmental Regulations and Industry Location*, 13 J. ENVT. DEV. 6 (2004); Stefan Ambec et al., *The Porter Hypothesis at 20: Can Environmental Regulation Enhance Innovation and Competitiveness?*, 7 REV. ENVTL. ECON. POL. 2 (2013); Michael Greenstone, *The Impacts of Environmental Regulations on Industrial Activity: Evidence from the 1970 and 1977 Clean Air Act Amendments and the Census of Manufactures*, 110 J. POL. ECON. 1175 (2002); Randy A. Becker, *Local Environmental Regulation and Plant-Level Productivity*, 70 ECOL. ECON. 2516 (2011).

288. MARTIN V. MELOSI, EFFLUENT AMERICA: CITIES, INDUSTRY, ENERGY, AND THE ENVIRONMENT 29 (2001) (describing how specific cities or areas became centers for particular industries, such as iron and steel making); STRADLING, *supra* note 36, at 10 (explaining that the high cost of shipping coal and coke caused energy-intensive industries to locate near productive coal mines in the 1800s and 1900s); DEWEY, *supra* note 45, at 177-79.

289. *See, e.g.*, Marius Brulhart, *Do Agglomeration Economies Reduce the Sensitivity of Firm Location to Tax Differentials?*, 122 ECON. J. 1069, 1069-70

their link to the positive spillovers associated with industry clustering provide further reason to question the value of direct federal regulation.[290]

The NSR and the PSD programs are often separately championed for promoting the deployment of new technologies.[291] While this claim has intuitive appeal, it is difficult to prove (the few available empirical studies are mixed[292]) and subject to countervailing considerations. First, the demand for better technologies would not go away in their absence. The NSPS program would provide a backstop, albeit one based on a weaker standard and more vulnerable to regulatory lags.[293] More importantly, urban areas still struggling to meet the NAAQS will, if past is prologue, continue to pressure industrial sources to reduce their emissions; absent this added layer of federal regulation, they could use alternative policy instruments. Second, economic efficiency is undermined when technology and environmental policies are conflated because

(2012) (concluding that agglomeration economies "can constrain the ability (and incentive) of jurisdictions to compete for firms via strategically low tax rates" or other economic incentives); Glenn Ellison et al., *What Causes Industry Agglomeration? Evidence from Coagglomeration Patterns*, 100 AM. ECON. REV. 1195, 1195-96 (2010).

290. One could argue that, consistent with the legislative intent of the 1977 Amendments, the PSD and NSR programs have enabled economic development in heavily industrialized areas to continue by limiting the emissions from each source. This may have been true for certain pollutants, notably SO_2 and PM, and sources (coal-fired power plants) in the 1970s and 80s, but it is hard to see how it could be true now when industrial sources are low in absolute and relative terms; in short, industrial sources are not the limiting factor in the difficult balance that the federal government and states are trying to strike between economic development and air quality.

291. *See, e.g.,* David M. Driesen, *Design, Trading, and Innovation*, *in* MOVING TO MARKETS IN ENVIRONMENTAL PROTECTION: LESSONS AFTER 20 YEARS OF EXPERIENCE 436, 437 (Jody Freeman & Charles D. Kolstad eds., 2007).

292. David Popp, *Pollution Control Innovations and the Clean Air Act of 1990*, 22 J. POL. ANALYSIS MGNT. 641, 655-59 (2003); Margaret R. Taylor et al., *Control of SO_2 Emissions from Power Plants: A Case of Induced Technological Innovation in the U.S.*, 72 TECH. FORECASTING SOC. CHANGE 697, 715-16 (2005).

293. The NSPS program operates as a floor for the stricter standards under the NSR and PSD programs, which avoid regulatory lags in updating control technologies because they are applied on a case-by-case basis.

each involves a distinct set of externalities.[294] Thus, while the PSD and NSR programs may enhance demand for new emissions-control technologies, this should be viewed as a secondary benefit that, on its own, would not justify retaining them.

The arguments presented in this section negate or qualify the conventional rationales for the PSD and NSR programs. However as noted earlier, coal-fired power plants and the Houston industrial complex are, in distinct ways, exceptions to the low levels of industrial emissions nationally. Both raise a complex set of issues, so I will merely outline how they could be addressed through substitute policies. Emissions of SO_2 and NO_x from electric utilities are regulated separately under two federal pollution trading programs, which have reduced emissions dramatically and are widely viewed as successful.[295] Although currently in the process of being restructured,[296] these trading regimes could obviate the need for the PSD and NSR programs.[297] Alternatively, while I would favor pollution trading regimes, limiting the PSD and NSR programs to coal-fired power plants, or equivalently increasing substantially the emissions thresholds for triggering them, would also be a reasonable approach that by retaining the programs may mitigate

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294. Adam Jaffe et al., *A Tale of Two Market Failures: Technology and Environmental Policy*, 54 ECOL. ECON. 164, 168–69 (2005) (highlighting the importance of innovation policies "as distinct from environmental policies [designed to] internaliz[e] environmental externalities").

295. Bachman, *supra* note 9, at 56-57, 60-61, 137-38; Sam Napolitano et al., *The U.S. Acid Rain Program: Key Insights from the Design, Operation, and Assessment of a Cap-and-Trade Program*, 20 ELECTRICITY J. 47, 52 (Aug./Sept. 2007).

296. Although in the second round of litigation and currently before the Supreme Court, EPA is continuing the process of restricting the programs administratively. Adam Liptak, *Justices to Hear Case on Cross-State Pollution Rules*, N.Y. TIMES, Dec. 10, 2013, at A21. It is important to note that the recent disruptions of these programs are not a sign of system failure, but rather more a product of litigation and statutory constraints. David A. Evans & Richard T. Woodward, *Experiment? The Collapse of the National SO_2 Trading Program and Implications for Tradable Permits as a Policy Instrument*, 5 ANN. REV. RESOURCE ECON. 325, 341-42 (2013).

297. Air quality around national parks, could be addressed separately by retaining the enhanced protections for air quality around national parks under the PSD program. 42 U.S.C. § 7472, 7473, 7491 (2006).

opposition.

Managing industrial emissions in the Houston area poses more challenging issues. One should recognize, though, that the PSD and NSR programs have not prevented the concentration of industries in the area, and may have reinforced it by grandfathering pre-1977 facilities.[298] Further, insofar as evidence exists of businesses being driven outside the Houston area, it appears that the limiting factor is the NSR requirement that new (or modified) facilities offset attendant increases in emissions.[299] Drawing on this anecdotal observation, an effective policy could involve basing the threshold for requiring emissions offsets on industrial emissions *collectively* exceeding an absolute level or a percentage of total emissions in a nonattainment area. This would create a better-calibrated disincentive against further buildup of heavily industrialize areas than the current NSR offset rule, which applies to all nonattainment areas regardless of the relative contributions of local industries. It is important to emphasize that this discussion is intended merely to illustrate the viability of alternative policies; a more complete treatment will have to wait for a subsequent paper.

Finally, I want to emphasize that I would not support eliminating the PSD and NSR programs without reforms to strengthen the pollution-trading regimes for electric utilities or to address climate change.[300] In light of the statutory limits exposed by pending and past litigation, most of the problems could be alleviated by expanding EPA's authority to enable it to adapt the trading regimes to mitigate interstate air pollution. Similarly, it would be foolish to forego the change to regulate industrial greenhouse-gas emissions under the PSD program

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298. The reasons for this perverse result is that new facilities and expansions often circumvent the PSD and NSR regulation by coming under grandfathered emissions caps of existing facilities.

299. *See* Mack & O'Brien Interview, *supra* note 216.

300. Alternatives to outright elimination of the programs could include the following: (1) cutting the long-criticized increment limits under the PSD program and thereby reducing it to a set of technology-based standards and strict limits on haze around national parks; (2) removing the offset requirements from the NSR program and thereby limiting it to a set of technology-based standards.

without new policies on climate change. Reforming the PSD and NSR programs is attractive because it would be viewed as a dramatic concession by environmentalists, but in practical effect it would have minimal environmental costs—both because the levels of industrial emissions are low and the NSPS program would be retained as a backstop. If used in the service of broader reforms, the political leverage would be substantial, particularly given the long-standing antipathy of industry advocates to the two programs. Moreover, while I appreciate that this proposal cuts against deeply held views, legislative action on issues such as climate change will be far less likely to occur if we fail to reconsider established beliefs or to exploit low-cost opportunities for compromise.

V.
CONCLUSIONS

The Clean Air Act is rightly celebrated as the most successful federal environmental law; this Article has argued that it may also be the most misunderstood. The two features of the statute viewed as integral to its effectiveness, the NAAQS and the statute's hybrid form of cooperative federal-state regulation, are in practice far less important than conventional views maintain. The NAAQS program plays a secondary role, whereas direct federal regulation is currently driving most improvements in air quality. For related reasons—the mix of overlapping programs, limits imposed by public and private opposition, and skewed distributions of emissions across source categories—state action is constrained or preempted with the result that cooperative federalism is more federal than it is cooperative.

None of these observations detracts from the many successes of the law. They suggest instead that the NAAQS program must be reoriented to address the political and structural barriers distinctive to reducing emissions from smaller sources. A principal reason I chose to address this topic is my concern that the misplaced sense of action encouraged by focusing unduly on industrial sources has become an obstacle to addressing these deeper problems. The opportunities for reform discussed in the final section are offered in this spirit as starting points for realignment of the statute and as opportunities to enable broader reforms to address climate change.